

## **Performance analysis of Drone Delivery System**

To be reviewed

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## **Drone Delivery System**

To be reviewed

Begin date: 21/09/2022 10:29:21

## **Safety**

### **Distribution center**

Application

R\_Saf - 1 >> Distribution center

Cause: DDS does not provide the received control action (Request a flight plan) from Distribution center. The DDS updates the system and did not accept the old style requisitions.  
Requirement: Distribution center must have ongoing analysis after system modification and use a standardized pattern to send control actions.

Mechanism: The system must use JSON pattern.

Performance Requirement: Distribution center must validate every JSON file before compute it.

Application: Support JSON files.

R\_Saf - 2 >> DDS

Cause: Feedback from DDS to Distribution center (Request status, Delivery status or List of periods) is missing.

Requirement: The communication from DDS to Distribution center must be improved or use a protocol that ensure the communication.

Mechanism: Use protocol that ensure the feedback delivery.

Performance Requirement: The communication protocol of DDS to Distribution center must ensure the delivery and be fast.

Application: The communication protocol is HTTP.

R\_Saf - 3 >> Distribution center

Cause: The Distribution center does not perform its functions to send control actions and receive feedback.

Requirement: The Distribution center must have ongoing analysis after system modification

and have replication to attend the demands.

Mechanism: Use VM to increase the requisitions attendance.

Performance Requirement: The Distribution center must have replication to be able to keep the communication in real time.

Application: Run in Linux operating systems.

R\_Saf - 4 >> Distribution center

Cause: Distribution center issued an incorrect (inappropriate) control action: Cancel a flight to DDS. The control action becomes ineffective after DDS updates.

Requirement: Distribution center algorithm must employ a file pattern to send control action and receive feedback.

Mechanism: Use JSON file format.

Performance Requirement: The Distribution center must respect the communication pattern of DDS.

Application: Support the JSON file format.

R\_Saf - 5 >> Distribution center

Cause: Distribution center does not provide (missing) the control action: Cancel a flight to DDS.

Requirement: The communication of Distribution center to DDS must be improved by using reliable protocol for send control actions.

Mechanism: The protocol is HTTP.

Performance Requirement: The communication protocol from Distribution center to DDS must ensure the delivery of communication and be fast.

Application: Must support HTTP.

R\_Saf - 6 >> Distribution center

Cause: DDS does not provide the received control action (Cancel a flight) from Distribution center.

Requirement: The DDS must have ongoing analysis after system modification and the algorithm must have a standardized protocol for send control actions.

Mechanism: Use the JSON file format.

Performance Requirement: The Distribution center must respect the DDS pattern for communication.

Application: Support JSON file format, and have the latest updates for communication standard of DDS.

## Interface I/O

R\_Saf - 7 >> Distribution center Algorithm/Logic

Cause: An incorrect Distribution center Algorithm/Logic was designed, and the Distribution center did not request or delay the request for a flight plan.

Requirement: The Distribution center Algorithm/Logic must be revised AND tested when updated to provide the request on time.

Mechanism: The Distribution center application must run in Linux system.

Performance Requirement: The Distribution center application must deal with 300 requisitions and answer in real time.

Interface I/O: Support one HPE Ethernet 10/25Gb 2 ports 10/100/1000.

## Memory

R\_Saf - 8 >> Distribution center Algorithm/Logic

Cause: An incorrect Distribution center Algorithm/Logic was designed, and the Distribution center did not request or delay the request for a flight plan.

Requirement: The Distribution center Algorithm/Logic must be revised AND tested when

updated to provide the request on time.

Mechanism: The Distribution center application must run in Linux system.

Performance Requirement: The Distribution center application must deal with 300 requisitions and answer in real time.

Memory: The RAM memory must be 8GB or higher.

R\_Saf - 9 >> Distribution center

Cause: The Distribution center does not perform its functions to communicate with DDS after software update.

Requirement: The Distribution center must have ongoing analysis after system modification, and be projected to operate in specific hardware.

Mechanism: RAM memory with 8 GB or higher, realiable link connection, and fast processor.

Performance Requirement: The system must operate with 40% free RAM memory and 60% of use of processor and link.

Memory: The system must have 8 GB of RAM memory or higher.

R\_Saf - 10 >> Distribution center

Cause: Distribution center does not provide (missing) the control action: Request a flight plan to DDS.

Requirement: The communication of Distribution center to DDS must be projected to operate in specific hardware.

Mechanism: Fast processor and reliable hardware.

Performance Requirement: The system must be able to request at least 150 flight plans in real time.

Memory: RAM memory with 8 GB or higher.

## Operating system

R\_Saf - 11 >> Distribution center Algorithm/Logic

Cause: An incorrect Distribution center Algorithm/Logic was designed, and the Distribution center did not request or delay the request for a flight plan.

Requirement: The Distribution center Algorithm/Logic must be revised AND tested when updated to provide the request on time.

Mechanism: The Distribution center application must run in Linux system.

Performance Requirement: The Distribution center application must deal with 300 requisitions and answer in real time.

Operating system: The operating system must be Linux long-term support.

R\_Saf - 12 >> Distribution center Algorithm/Logic

Cause: An incorrect Distribution center Algorithm/Logic was designed.

Requirement: The Distribution center Algorithm/Logic must be revised AND tested when updated. Distribution center algorithm must be projected to operate in a reliable operating system.

Mechanism: The application must support Linux based systems.

Performance Requirement: The operating system must be long-term support.

Operating system: The operating system is Linux long-term support.

R\_Saf - 13 >> Distribution center

Cause: The Distribution center does not perform its functions to send control actions and receive feedback.

Requirement: The Distribution center must have ongoing analysis after system modification and have replication to attend the demands.

Mechanism: Use VM to increase the requisitions attendance.

Performance Requirement: The Distribution center must have replication to be able to keep the communication in real time.

Operating system: Support the use of VM.

## Physical link

### R\_Saf - 14 >> DDS

Cause: Feedback from DDS to Distribution center (Request status, Delivery status or List of periods) is missing, and the Distribution center did not receive ou received delayed the flight plan approved or denied.

Requirement: The communication from DDS to Distribution center must be improved and have a reliable link for feedback.

Mechanism: Distribution center must have an alternative internet link.

Performance Requirement: Each link must be able to support all the DDS requisitions.

Physical link: Distribution center must have two distinct links, each one must support 500 Mbps of down and 500 Mbps of up.

### R\_Saf - 15 >> Distribution center

Cause: The Distribution center does not perform its functions to communicate with DDS after software update.

Requirement: The Distribution center must have ongoing analysis after system modification, and be projected to operate in specific hardware.

Mechanism: RAM memory with 8 GB or higher, realiable link connection, and fast processor.

Performance Requirement: The system must operate with 40% free RAM memory and 60% of use of processor and link.

Physical link: Distribution center must have two distinct links, each one must support 500 Mbps of down and 500 Mbps of up.

## Processor

### R\_Saf - 16 >> Distribution center Algorithm/Logic

Cause: An incorrect Distribution center Algorithm/Logic was designed, and the Distribution center did not request or delay the request for a flight plan.

Requirement: The Distribution center Algorithm/Logic must be revised AND tested when updated to provide the request on time.

Mechanism: The Distribution center application must run in Linux system.

Performance Requirement: The Distribution center application must deal with 300 requisitions and answer in real time.

Processor: The processor must be dual and scalable.

### R\_Saf - 17 >> Distribution center

Cause: The Distribution center does not perform its functions to communicate with DDS after software update.

Requirement: The Distribution center must have ongoing analysis after system modification, and be projected to operate in specific hardware.

Mechanism: RAM memory with 8 GB or higher, realiable link connection, and fast processor.

Performance Requirement: The system must operate with 40% free RAM memory and 60% of use of processor and link.

Processor: Processor must be scalable.

### R\_Saf - 18 >> Distribution center

Cause: Distribution center does not provide (missing) the control action: Request a flight plan to DDS.

Requirement: The communication of Distribution center to DDS must be projected to operate in specific hardware.

Mechanism: Fast processor and reliable hardware.

Performance Requirement: The system must be able to request at least 150 flight plans in real time.

Processor: Dual and scalable processor.

## Storage

R\_Saf - 19 >> Distribution center Algorithm/Logic

Cause: An incorrect Distribution center Algorithm/Logic was designed, and the Distribution center did not request or delay the request for a flight plan.

Requirement: The Distribution center Algorithm/Logic must be revised AND tested when updated to provide the request on time.

Mechanism: The Distribution center application must run in Linux system.

Performance Requirement: The Distribution center application must deal with 300 requisitions and answer in real time.

Storage: The system must have 2 TB of free memory.

R\_Saf - 20 >> Distribution center

Cause: Distribution center issued an incorrect (inappropriate) control action: Request a flight plan to DDS. The control action becomes inappropriate or ineffective after DDS updates.

Requirement: The process model in Distribution center must represent the Delivery process and DDS and be updated after each interaction with DDS.

Mechanism: The distribution center must use a centralized database.

Performance Requirement: The database must be centralized and deal with 400 requisitions at real time.

Storage: Distribution center must have 500 GB or higher.

## Customer

### Application

R\_Saf - 21 >> Virtual store

Cause: The Customer did not receive the feedback from Virtual store to Customer (Request status, Delivery status or List of periods) is missing.

Requirement: The communication from Virtual store to Customer must be improved by using a communication protocol that ensures the delivery in a fast way.

Mechanism: Use communication protocols that ensure the communication.

Performance Requirement: The communication chosen by Virtual store must be accomplished and must be fast.

Application: Support HTTP protocol.

R\_Saf - 22 >> Customer

Cause: Customer does not provide (missing) the control action: Request the period for delivery; to Virtual store.

Requirement: The communication of Customer to Virtual store must be improved by using reliable protocol to send the control actions.

Mechanism: Use reliable protocol and JSON file format.

Performance Requirement: The communication must be accomplished according to the pattern defined by Virtual store.

Application: The protocol is HTTP and the file pattern is JSON.

R\_Saf - 23 >> Customer

Cause: Virtual store does not provide the received control action (Request the period for delivery) from Customer.

Requirement: The Virtual store must have ongoing analysis after system modification and use a standardized pattern for send control actions to Virtual store.

Mechanism: Use the JSON file format as a communication standard.

Performance Requirement: The Customer must use only reliable and fast communication protocols.

Application: Support the JSON file format.

Interface I/O

Memory

Operating system

Physical link

R\_Saf - 24 >> Virtual store

Cause: The Customer did not receive the feedback from Virtual store to Customer (Request status, Delivery status or List of periods) is missing.

Requirement: The communication from Virtual store to Customer must be improved by using a communication protocol that ensures the delivery in a fast way.

Mechanism: Use communication protocols that ensure the communication.

Performance Requirement: The communication chosen by Virtual store must be accomplished and must be fast.

Physical link: Virtual store must have an alternative link with 500 Mbps of download speed and 500 Mbps of upload speed.

Processor

R\_Saf - 25 >> Customer

Cause: Customer does not provide (missing) the control action: Request the period for delivery; to Virtual store.

Requirement: The communication of Customer to Virtual store must be improved by using reliable protocol to send the control actions.

Mechanism: Use reliable protocol and JSON file format.

Performance Requirement: The communication must be accomplished according to the pattern defined by Virtual store.

Processor: Processor must have at least 1.3 Ghz or higher.

Storage

**DDS**

Application

R\_Saf - 26 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must be projected for a specific hardware AND revised AND tested when updated.

Mechanism: Application and operating system with real-time answers.

Performance Requirement: The application must provide the control action in less than 2

seconds.

Application: Must run on linux based systems.

R\_Saf - 27 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must have ongoing analysis after system modification. The system must have also a replication.

Mechanism: The application must support replication.

Performance Requirement: The application must be constructed to be replicated and operate without generate conflict among them.

Application: Support replications and operates on Linux based systems.

R\_Saf - 28 >> DDS

Cause: DDS does not provide (missing) the control action: Start flight to Drone.

Requirement: The communication of DDS to Drone must be improved by using protocols that ensure the control action delivery.

Mechanism: The application protocol is HTTP and network must be 4G or higher.

Performance Requirement: The DDS communication to the drone must take less than 5 seconds to be accomplished.

Application: Application must support HTTP.

R\_Saf - 29 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The communication from Drone to DDS must be improved by using protocols that ensure the message delivery.

Mechanism: The application protocol is HTTP and network layer protocol is 4G or higher.

Performance Requirement: The communication must take less than 5 seconds.

Application: DDS application must support replication.

R\_Saf - 30 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Scalable system.

Performance Requirement: DDS application and must support replication and be scalable.

Application: Application must support replication and multiple instances.

R\_Saf - 31 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must be revised AND tested to provide the control action on time.

Mechanism: DDS application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 32 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low time complexity to provide Start flight on the right time.

Mechanism: The application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 33 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: The DDS Algorithm/Logic must be updated AND revised AND tested. The DDS Algorithm must be tested on emulator and real drone before be approved.

Mechanism: Application must support scalability.

Performance Requirement: The application must be scalable according to the demand.

Application: Application must support replication.

R\_Saf - 34 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.

Requirement: The process model of DDS must represent the Delivery process and Drone, and improve the communication between DDS and Drone.

Mechanism: Replication of the application.

Performance Requirement: The DDS must have priority to process the Drone feedback.

Application: Must have at least one instance of the application only to attend the drones requests.

R\_Saf - 35 >> USS

Cause: Feedback from USS to DDS (Flight plan status, Flight cancelled or Flight intentions) is missing.

Requirement: DDS must have a dedicated instance of the application to process the USS feedback.

Mechanism: Replication of application.

Performance Requirement: DDS must have at least one instance of application to attend the USS requests.

Application: Must have at least one instance of the application only to attend the USS requests.

R\_Saf - 36 >> USS

Cause: Feedback from USS to DDS is delayed.

Requirement: The feedback from USS to DDS must have alternative link or improve the link, and fast processor .

Mechanism: Fast link connection and dedicated instance of application.

Performance Requirement: DDS must have at least one instance of application only for attend USS requests.

Application: Must have at least one instance of the application only to attend the USS requests.

R\_Saf - 37 >> DDS

Cause: DDS does not provide (missing) the control action: Back to home to Drone.

Requirement: The communication of DDS to Drone must be improved and have a dedicated instance of the application to communicate with drone.

Mechanism: Fast internet connection and dedicated application.

Performance Requirement: The DDS must have one instance of the application only for the drone, and have a fast internet link.

Application: One instance of application to control the drones.

R\_Saf - 38 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low space complexity, be revised AND tested when updated.

Mechanism: Fast processor and RAM memory.

Performance Requirement: The DDS application must be able to provide the control actions and receive feedback without delay.

Application: Support multiple instances of application and HTTP protocol.



R\_Saf - 39 >> Drone

Cause: Feedback from Drone to DDS (Drone delivery status) is missing.

Requirement: The communication link from Drone to DDS must be fast.

Mechanism: Reliable link connection.

Performance Requirement: The system must have at least one instance of application to control the Drone.

Application: DDS must have one instance of the application to control the Drone.

R\_Saf - 40 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time. The application must operate using 60% of RAM memory and less than 80% of system capacity.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 41 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Scalable Virtual Machine, fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 42 >> Drone

Cause: Drone does not provide the received control action (Go to position) from DDS.

Requirement: The Drone must have ongoing analysis after system modification and DDS must send control actions that can be processed by Drone.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS must have a processor fast enough, and the average usage of RAM memory must be under than 60%, and use a fast internet connection to ensure that Drone will receive the control action in less than 4 seconds.

Application: Must support replication.

R\_Saf - 43 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time to send control actions to the drones.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 44 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time, the connection link must be fast and have redundancy.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 45 >> Drone

Cause: Drone does not provide the received control action (Go to position) from DDS.

Requirement: The Drone must have ongoing analysis after system modification and DDS

must employs protocols that ensure the delivery.

Mechanism: Fast processor, RAM memory with less than 60%, fast connection, and Lorawan protocol.

Performance Requirement: Drone must never be overloaded with requisitions of DDS.

Application: DDS application must have low complexity and use JSON standard to communicate with drone. DDS application must use ZigBee protocol to communicate with Drone

R\_Saf - 46 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must provide the prompt and right answer in less than 1 second.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 47 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The communication from Drone to DDS must use fast and reliable link, and employ protocols that guarantee the message delivery.

Mechanism: Reliable connection, fast connection, and HTTP protocol.

Performance Requirement: The system must be available to receive the Drone feedback.

Application: DDS must support HTTP protocol.

R\_Saf - 48 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application running on a Virtual Machine must never be overloaded.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 49 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must be able to process the feedback in time to provide the correct control actions and use realible protocols.

Mechanism: Fast processor, fast connection, and HTTP protocol.

Performance Requirement: The Virtual machine must have 60% of RAM memory used and 80% of CPU and link being used under normal situation.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 50 >> Drone

Cause: Drone does not provide the received control action (Go to position) from DDS.

Requirement: The Drone must have ongoing analysis after system modification and DDS must send a standardized control actions.

Mechanism: Fast processor, RAM memory with less than 60%, fast connection, and Lorawan protocol.

Performance Requirement: DDS must be able to send the control action to the Drone is less than 5 seconds.

Application: DDS application must have low complexity and use JSON standard to communicate with drone. DDS application must use ZigBee protocol to communicate with Drone

R\_Saf - 51 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must employ protocols that ensure the message delivery and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: Each Virtual Machine must never be overloaded to provide its functions.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 52 >> Drone

Cause: Feedback from Drone to DDS (Drone position, Emergency situation, Drone delivery status) is missing.

Requirement: DDS must have a reliable link and use a standardized pattern to send control actions.

Mechanism: Reliable connection, fast connection, and HTTP protocol.

Performance Requirement: The communication must take less than 5 seconds.

Application: DDS application must have low complexity and use JSON standard to communicate with drone. DDS application must use ZigBee protocol to communicate with Drone

R\_Saf - 53 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 54 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: The communication of DDS to Drone must be improved. DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, HTTP protocol, and alternative link connection.

Performance Requirement: DDS system must be able to control the number of virtual machines that have the application in real-time and have reliable and fast communication.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 55 >> Drone

Cause: Drone does not provide the received control action (Go to position) from DDS.

Requirement: DDS must use reliable protocol to send control actions to Drone.

Mechanism: HTTP protocol.

Performance Requirement: The communication protocol of DDS must ensure the delivery of control action to the Drone.

Application: Support HTTP protocol.

R\_Saf - 56 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be tested with emulator and real drones before be implemented.

Mechanism: Use Virtual Machine to run application

Performance Requirement: The system must support several instances and run on a Virtual Machine.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 57 >> Drone

Cause: Feedback from Drone to DDS (Drone position) is missing. DDS believes that the

Drone is returning of a delivery.

Requirement: The communication from Drone to DDS must be improved. DDS algorithm must employs protocols that ensure the message delivery.

Mechanism: HTTP protocol.

Performance Requirement: The communication protocol with Drone and DDS must be able to send the communication in less than 1 second.

Application: Support HTTP protocol.

R\_Saf - 58 >> DDS

Cause: USS does not provide the received control action (Request flight intentions, Request flight plan or Cancel flight plan) from DDS.

Requirement: The USS must have ongoing analysis after system modification, and DDS must respect the pattern required by USS to send the control action to require flight plan.

Mechanism: JSON pattern.

Performance Requirement: DDS must be able to communicate with USS in less than 5 seconds.

Application: Support the use of JSON pattern.

R\_Saf - 59 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: The algorithm must respect the standardized pattern to communicate with USS.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 60 >> Drone

Cause: Drone delays to provide the received control action (Back to home) from DDS.

Requirement: DDS must provide the control action in time and use a fast connection.

Mechanism: Reliable hardware and fast connection.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Application: Must support HTTP protocol.

R\_Saf - 61 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is delayed or missing.

Requirement: DDS algorithm must employs protocols that ensure the message delivery/receive.

Mechanism: Fast processor and reliable connection.

Performance Requirement: The feedback must be received by DDS in less than 1 second.

Application: DDS application must support HTTP protocol.

R\_Saf - 62 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS algorithm must be projected to operate in specific hardware and have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 63 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines that runs the application.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 64 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to send control actions to the Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 65 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to provide control actions to Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Application: Support multiple instances of application and HTTP protocol.

R\_Saf - 66 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS hardware must support algorithm upgrades.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Application: Support HTTP communication protocol.

R\_Saf - 67 >> Drone

Cause: Drone does not provide the received control action (Start flight) from DDS.

Requirement: The Drone must employ protocols and standards that ensure the message delivery and have ongoing analysis after system modification.

Mechanism: JSON standard and ZigBee protocol.

Performance Requirement: The control action sent by DDS must be enforced and delivered to Drone.

Application: DDS application must have low complexity and use JSON standard to communicate with drone. DDS application must use ZigBee protocol to communicate with Drone

R\_Saf - 68 >> Drone

Cause: Drone does not provide the received control action (Start flight) from DDS.

Requirement: The Drone must be projected for a model of drone and have ongoing analysis after system modification.

Mechanism: Reliable communication protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Application: Support HTTP protocol.

R\_Saf - 69 >> Drone

Cause: Drone does not provide the received control action (Go to position) from DDS.

Requirement: Every control action must be tested with the emulator and with the real drone several times before being adopted.

Mechanism: Reliable communication protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time

to Drone.

Application: Support HTTP protocol.

R\_Saf - 70 >> Drone

Cause: Drone does not provide the received control action (Back to home) from DDS.

Requirement: DDS must use reliable protocol to communicate with Drone and have ongoing analysis after system modification.

Mechanism: JSON standard and ZigBee.

Performance Requirement: The control action sent by DDS must be enforced and delivered to Drone.

Application: DDS application must have low complexity and use JSON standard to communicate with drone. DDS application must use ZigBee protocol to communicate with Drone

R\_Saf - 71 >> Drone

Cause: Drone does not provide the received control action (Back to home) from DDS.

Requirement: Every control action must be tested on emulator and real drone several times before be adopted.

Mechanism: Reliable communication protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Application: Support HTTP protocol.

## Interface I/O

R\_Saf - 72 >> DDS

Cause: DDS does not provide (missing) the control action: Start flight to Drone.

Requirement: The communication of DDS to Drone must be improved by using protocols that ensure the control action delivery.

Mechanism: The application protocol is HTTP and network must be 4G or higher.

Performance Requirement: The DDS communication to the drone must take less than 5 seconds to be accomplished.

Interface I/O: Cellular connection.

R\_Saf - 73 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The communication from Drone to DDS must be improved by using reliable link and employ fast protocols that ensure the message delivery.

Mechanism: Reliable link connection and HTTP protocol.

Performance Requirement: DDS must be able to receive drone feedback is less than 5 seconds.

Interface I/O: Cellular network connection.

R\_Saf - 74 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The communication from Drone to DDS must use fast and reliable link, and employ protocols that guarantee the message delivery.

Mechanism: Reliable connection, fast connection, and HTTP protocol.

Performance Requirement: The system must be available to receive the Drone feedback.

Interface I/O: Cellular network connection.

R\_Saf - 75 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be tested on emulator and real drone before be approved.

Mechanism:

Performance Requirement: The transmission of the updates of operating must occurs only at the DDS base, using a low range technology.

Interface I/O: Bluetooth 4.0 for DDS update the Drone operating system.

R\_Saf - 76 >> Drone

Cause: Feedback from Drone to DDS (Operating system version) is missing.

Requirement: The communication link from Drone to DDS to update the operating system must work in low range.

Mechanism: Bluetooth 4.0.

Performance Requirement: The transmission of the updates of operating must occurs only at the DDS base, using a low range technology.

Interface I/O: Bluetooth 4.0 for DDS update the Drone operating system.

R\_Saf - 77 >> DDS

Cause: DDS does not provide (missing) the control action: Update drone system; to Drone.

Requirement: Drone must be in range of DDS bluetooth.

Mechanism: Bluetooth 4.0.

Performance Requirement: The transmission of the updates of operating must occurs only at the DDS base, using a low range technology.

Interface I/O: Bluetooth 4.0 for DDS update the Drone operating system.

## Memory

R\_Saf - 78 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong due to the delay to process the Drone feedback. The process model was not updated with current informations.

Requirement: The process model must be stored in RAM memory during its use.

Mechanism: More processor, more RAM memory, reliable link and more link speed.

Performance Requirement: The DDS must have scalable system to receive the Distribution center requisition, USS feedback, and Drone feedback.

Memory: Each instance of DDS must have 8 GB of RAM memory.

R\_Saf - 79 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must be revised AND tested to provide the control action on time.

Mechanism: DDS application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Memory: Each Virtual Machine must have 8GB of RAM memory.

R\_Saf - 80 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low time complexity to provide Start flight on the right time.

Mechanism: The application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Memory: Each Virtual Machine must have 8GB of RAM memory.

R\_Saf - 81 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Fast processor, and RAM memory with less than 60% of use.  
Performance Requirement: The average of resource utilization of RAM memory must be 60%.  
Memory: 8 GB of RAM memory.

R\_Saf - 82 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low space complexity, be revised AND tested when updated.

Mechanism: Fast processor and RAM memory.

Performance Requirement: The DDS application must be able to provide the control actions and receive feedback without delay.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

R\_Saf - 83 >> DDS

Cause: DDS delays to provide the control action: Back to home to Drone.

Requirement: The communication link of DDS to Drone must be improved and send only the information to controls the Drone.

Mechanism: Fast processor, RAM memory, reliable connection.

Performance Requirement: DDS must provide the control actions in less than 1 second.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

R\_Saf - 84 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, reliable and fast link connection.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Memory: 8 GB of RAM memory.

R\_Saf - 85 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time. The application must operate using 60% of RAM memory and less than 80% of system capacity.

Memory: 8 GB of RAM memory.

R\_Saf - 86 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Scalable Virtual Machine, fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time.

Memory: 8 GB of RAM memory.

R\_Saf - 87 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must have low complexity and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, reliable and fast link connection.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Memory: At least 8 GB of RAM memory dedicated to the application.



R\_Saf - 88 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time to send control actions to the drones.

Memory: 8 GB of RAM memory.

R\_Saf - 89 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time, the connection link must be fast and have redundancy.

Memory: 8 GB of RAM memory.

R\_Saf - 90 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must provide the prompt and right answer in less than 1 second.

Memory: 8 GB of RAM memory.

R\_Saf - 91 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application running on a Virtual Machine must never be overloaded.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

R\_Saf - 92 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must employs protocols that ensure the message delivery and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: Each Virtual Machine must never be overloaded to provide its functions.

Memory: Each virtual machine must have 8 GB of RAM or more.

R\_Saf - 93 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Memory: Each Virtual Machine must have 8GB of RAM memory.

R\_Saf - 94 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: The communication of DDS to Drone must be improved. DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message

delivery.

Mechanism: Fast processor, RAM memory, HTTP protocol, and alternative link connection.

Performance Requirement: DDS system must be able to control the number of virtual machines that have the application in real-time and have reliable and fast communication.

Memory: Each Virtual Machine must have 8 GB of RAM or more.

R\_Saf - 95 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be tested with emulator and real drones before be implemented.

Mechanism: Use Virtual Machine to run application

Performance Requirement: The system must must supports several instances and run on a Virtual Machine.

Memory: Every Virtual Machine must have 8 GB of RAM memory.

R\_Saf - 96 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: The algorithm must respect the standardized pattern to communicate with USS.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

R\_Saf - 97 >> DDS

Cause: DDS delays to provide (delayed) the control action: Request flight plan to USS.

Requirement: The communication of DDS to USS must be improved with a fast and reliable link connection.

Mechanism: Fast processor, RAM memory, and fast and reliable link connection.

Performance Requirement: The control action must be provided in less than 1 second.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

R\_Saf - 98 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS algorithm must be projected to operate in specific hardware and have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

R\_Saf - 99 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines that runs the application.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

R\_Saf - 100 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to send control actions to the Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

#### R\_Saf - 101 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to provide control actions to Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

#### R\_Saf - 102 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: DDS algorithm must run in a specific hardware configuration.

Mechanism: Fast processor, RAM memory and free storage.

Performance Requirement: The resource usage must be under than 80% for each Virtual Machine.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

#### R\_Saf - 103 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS hardware must support algorithm upgrades.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Memory: Each Virtual Machine must have 8 GB of RAM memory.

### Operating system

#### R\_Saf - 104 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must be projected for a specific hardware AND revised AND tested when updated.

Mechanism: Application and operating system with real-time answers.

Performance Requirement: The application must provide the control action in less than 2 seconds.

Operating system: Linux based system that supports Virtual Machine.

#### R\_Saf - 105 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must have ongoing analysis after system modification. The system must have also a replication.

Mechanism: The application must support replication.

Performance Requirement: The application must be constructed to be replicated and operate without generate conflict among them.

Operating system: The operating system is linux based and supports Virtual Machine.

#### R\_Saf - 106 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The communication from Drone to DDS must be improved by using protocols that ensure the message delivery.

Mechanism: The application protocol is HTTP and network layer protocol is 4G or higher.

Performance Requirement: The communication must take less than 5 seconds.

Operating system: DDS operating system must support scalable virtual machine.

#### R\_Saf - 107 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong due to the delay to process the Drone feedback. The process model was not updated with current informations.

Requirement: The process model must be stored in RAM memory during its use.

Mechanism: More processor, more RAM memory, reliable link and more link speed.

Performance Requirement: The DDS must have scalable system to receive the Distribution center requisition, USS feedback, and Drone feedback.

Operating system: DDS operating system must support Virtual Machine.

#### R\_Saf - 108 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Scalable system.

Performance Requirement: DDS application and must support replication and be scalable.

Operating system: Must support scalable Virtual Machine.

#### R\_Saf - 109 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must be revised AND tested to provide the control action on time.

Mechanism: DDS application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Operating system: Linux based system and support Virtual Machine.

#### R\_Saf - 110 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low time complexity to provide Start flight on the right time.

Mechanism: The application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Operating system: Linux based system and support Virtual Machine.

#### R\_Saf - 111 >> DDS

Cause: DDS does not provide (missing) the control action: Back to home to Drone.

Requirement: The communication of DDS to Drone must be improved and have a dedicated instance of the application to communicate with drone.

Mechanism: Fast internet connection and dedicated application.

Performance Requirement: The DDS must have one instance of the application only for the drone, and have a fast internet link.

Operating system: The operating system must support multiple Virtual Machine.

#### R\_Saf - 112 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low space complexity, be revised AND tested when updated.

Mechanism: Fast processor and RAM memory.

Performance Requirement: The DDS application must be able to provide the control actions and receive feedback without delay.

Operating system: Linux based system and support Virtual Machine.

#### R\_Saf - 113 >> Drone

Cause: Feedback from Drone to DDS (Drone delivery status) is missing.

Requirement: The communication link from Drone to DDS must be fast.

Mechanism: Reliable link connection.

Performance Requirement: The system must have at least one instance of application to control the Drone.

Operating system: DDS operating system must support virtual machines.

#### R\_Saf - 114 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time. The application must operate using 60% of RAM memory and less than 80% of system capacity.

Operating system: Linux based system and support Virtual Machine.

#### R\_Saf - 115 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Scalable Virtual Machine, fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time.

Operating system: Linux based system and support Virtual Machine.

#### R\_Saf - 116 >> Drone

Cause: Drone does not provide the received control action (Go to position) from DDS.

Requirement: The Drone must have ongoing analysis after system modification and DDS must send control actions that can be processed by Drone.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS must have a processor fast enough, and the average usage of RAM memory must be under than 60%, and use a fast internet connection to ensure that Drone will receive the control action in less than 4 seconds.

Operating system: DDS operating system must support scalable virtual machines.

#### R\_Saf - 117 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time to send control actions to the drones.

Operating system: Linux based system and support Virtual Machine.

#### R\_Saf - 118 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time, the connection link must be fast and have redundancy.

Operating system: Linux based system and support Virtual Machine.

#### R\_Saf - 119 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must provide the prompt and right answer in less

than 1 second.

Operating system: Linux based system.

R\_Saf - 120 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The communication from Drone to DDS must use fast and reliable link, and employ protocols that guarantee the message delivery.

Mechanism: Reliable connection, fast connection, and HTTP protocol.

Performance Requirement: The system must be available to receive the Drone feedback.

Operating system: Drone must support HTTP protocol.

R\_Saf - 121 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application running on a Virtual Machine must never be overloaded.

Operating system: Linux based system.

R\_Saf - 122 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must employs protocols that ensure the message delivery and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: Each Virtual Machine must never be overloaded to provide its functions.

Operating system: Run over Linux based system.

R\_Saf - 123 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Operating system: Linux based system and support Virtual Machine.

R\_Saf - 124 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: The communication of DDS to Drone must be improved. DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, HTTP protocol, and alternative link connection.

Performance Requirement: DDS system must be able to control the number of virtual machines that have the application in real-time and have reliable and fast communication.

Operating system: Linux based system and support Virtual Machine.

R\_Saf - 125 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be tested with emulator and real drones before be implemented.

Mechanism: Use Virtual Machine to run application

Performance Requirement: The system must must supports several instances and run on a Virtual Machine.

Operating system: Linux based system and support Virtual Machine.

R\_Saf - 126 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: The algorithm must respect the standardized pattern to communicate with USS.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Operating system: Linux based system and support Virtual Machine.

R\_Saf - 127 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS algorithm must be projected to operate in specific hardware and have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Operating system: Linux based system and support Virtual Machine.

R\_Saf - 128 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines that runs the application.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Operating system: Linux based system and support Virtual Machine.

R\_Saf - 129 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to send control actions to the Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Operating system: Linux based system and support Virtual Machine.

R\_Saf - 130 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to provide control actions to Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Operating system: Linux based system and support Virtual Machine.

R\_Saf - 131 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS hardware must support algorithm upgrades.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Operating system: Linux based system and support Virtual Machine.

Physical link

R\_Saf - 132 >> DDS

Cause: DDS does not provide (missing) the control action: Start flight to Drone.

Requirement: The communication of DDS to Drone must be improved by using protocols that ensure the control action delivery.

Mechanism: The application protocol is HTTP and network must be 4G or higher.

Performance Requirement: The DDS communication to the drone must take less than 5 seconds to be accomplished.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

#### R\_Saf - 133 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong due to the delay to process the Drone feedback. The process model was not updated with current informations.

Requirement: The process model must be stored in RAM memory during its use.

Mechanism: More processor, more RAM memory, reliable link and more link speed.

Performance Requirement: The DDS must have scalable system to receive the Distribution center requisition, USS feedback, and Drone feedback.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

#### R\_Saf - 134 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must be revised AND tested to provide the control action on time.

Mechanism: DDS application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

#### R\_Saf - 135 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low time complexity to provide Start flight on the right time.

Mechanism: The application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

#### R\_Saf - 136 >> USS

Cause: Feedback from USS to DDS (Flight plan status) is missing.

Requirement: The communication from USS to DDS must be improved by having reliable connection.

Mechanism: Reliable link for internet connection.

Performance Requirement: The link for internet connection must be fast and reliable.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

#### R\_Saf - 137 >> USS

Cause: Feedback from USS to DDS is delayed.

Requirement: The feedback from USS to DDS must have alternative link with fast connection.

Mechanism: Reliable link for internet connection.

Performance Requirement: The link for internet connection must be fast and reliable.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

#### R\_Saf - 138 >> DDS

Cause: DDS delays to provide the control action: Start flight to Drone.

Requirement: The communication link of DDS to Drone must be improved and the DDS algorithm must have low time complexity.

Mechanism: Fast and reliable connection.

Performance Requirement: The system must have a reliable connection or alternative link.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.



R\_Saf - 139 >> USS

Cause: Feedback from USS to DDS is delayed.

Requirement: The feedback from USS to DDS must have alternative link or improve the link, and fast processor .

Mechanism: Fast link connection and dedicated instance of application.

Performance Requirement: DDS must have at least one instance of application only for attend USS requests.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 140 >> Weather system

Cause: Weather system is missing.

Requirement: The communication of the external system to DDS must be improved. DDS must have a fast connection and be able to process the Weather information.

Mechanism: Fast link and fast processor.

Performance Requirement: The system must have fast link to receive the information and fast processor to process the information.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 141 >> DDS

Cause: DDS does not provide (missing) the control action: Back to home to Drone.

Requirement: The communication of DDS to Drone must be improved and have a dedicated instance of the application to communicate with drone.

Mechanism: Fast internet connection and dedicated application.

Performance Requirement: The DDS must have one instance of the application only for the drone, and have a fast internet link.

Physical link: The internet connection must have at least 500 Mbps of download and 500 Mbps of upload.

R\_Saf - 142 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low space complexity, be revised AND tested when updated.

Mechanism: Fast processor and RAM memory.

Performance Requirement: The DDS application must be able to provide the control actions and receive feedback without delay.

Physical link: 500 Mbps of download and 500 Mbps of upload.

R\_Saf - 143 >> USS

Cause: Feedback from USS to DDS is delayed.

Requirement: The feedback from USS to DDS must have alternative and fast link connection.

Mechanism: Reliable link for internet connection and fast processor.

Performance Requirement: The link for internet connection must be fast and reliable. The processor must be able to process the feedback.

Physical link: 500 Mbps of download and 500 Mbps of upload.

R\_Saf - 144 >> DDS

Cause: DDS delays to provide the control action: Back to home to Drone.

Requirement: The communication link of DDS to Drone must be improved and send only the information to controls the Drone.

Mechanism: Fast processor, RAM memory, reliable connection.

Performance Requirement: DDS must provide the control actions in less than 1 second.

Physical link: 500 Mbps of download and 500 Mbps of upload.

R\_Saf - 145 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, reliable and fast link connection.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Physical link: Dual link for internet connection. Each link must have 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 146 >> Weather system

Cause: Weather system is missing.

Requirement: The communication link of the external system to DDS must have a fast connection. DDS must be able to process the Weather information.

Mechanism: Reliable link connection and fast processor.

Performance Requirement: The system must have fast link to receive the information and fast processor to process the information.

Physical link: Must have 500 Mbps of download and 500 Mbps of upload.

R\_Saf - 147 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time. The application must operate using 60% of RAM memory and less than 80% of system capacity.

Physical link: 500 Mbps of download and 500 Mbps of upload.

R\_Saf - 148 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Scalable Virtual Machine, fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time.

Physical link: 500 Mbps download and 500 Mbps upload.

R\_Saf - 149 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must have low complexity and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, reliable and fast link connection.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Physical link: At least 100 Mbps download and 100 Mbps upload of link speed dedicated

R\_Saf - 150 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.

Requirement: DDS must have a reliable link and employ protocols that ensure the message delivery.

Mechanism: Reliable and dedicated link.

Performance Requirement: DDS must have a dedicated connection link to control the drones.

Physical link: 500 Mbps download and 500 Mbps upload.

R\_Saf - 151 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The communication from Drone to DDS must be improved by using reliable link and employ fast protocols that ensure the message delivery.

Mechanism: Reliable link connection and HTTP protocol.

Performance Requirement: DDS must be able to receive drone feedback is less than 5 seconds.

Physical link: Dual link for internet connection. Each link must have 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 152 >> Weather system

Cause: Weather system is missing.

Requirement: DDS must have a fast connection to receive the Wheather information.

Mechanism: Fast link connection.

Performance Requirement: The system must have fast link to receive the information and fast processor to process the information.

Physical link: Must have 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 153 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time to send control actions to the drones.

Physical link: 500 Mbps of download and 500 Mbps of upload of link speed.

R\_Saf - 154 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time, the connection link must be fast and have redundancy.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 155 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must provide the prompt and right answer in less than 1 second.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 156 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.

Requirement: DDS must have be able to process the feedback to provide the right control actions, and use a reliable link.

Mechanism: Fast and reliable connection.

Performance Requirement: The process model must have priority to be always updated.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 157 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The communication from Drone to DDS must use fast and reliable link, and employ protocols that guarantee the message delivery.

Mechanism: Reliable connection, fast connection, and HTTP protocol.

Performance Requirement: The system must be available to receive the Drone feedback.

Physical link: The connection link must have 500 Mbps download and 500 Mbps upload of

speed.

R\_Saf - 158 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application running on a Virtual Machine must never be overloaded.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 159 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must employs protocols that ensure the message delivery and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: Each Virtual Machine must never be overloaded to provide its functions.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 160 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.

Requirement: DDS must have a reliable link and be able to process the feedback to provide the right control actions.

Mechanism: Reliable connection and fast processor.

Performance Requirement: DDS must have a fast link and be able to process on time all the control action and feedback.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 161 >> Drone

Cause: Feedback from Drone to DDS (Drone position, Emergency situation, Drone delivery status) is missing.

Requirement: DDS must have a reliable link and use a standardized pattern to send control actions.

Mechanism: Reliable connection, fast connection, and HTTP protocol.

Performance Requirement: The communication must take less than 5 seconds.

Physical link: At least 10 Mbps download and 10 Mbps upload of speed.

R\_Saf - 162 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 163 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: The communication of DDS to Drone must be improved. DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, HTTP protocol, and alternative link connection.

Performance Requirement: DDS system must be able to control the number of virtual machines that have the application in real-time and have reliable and fast communication.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 164 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: The algorithm must respect the standardized pattern to communicate with USS.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 165 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.

Requirement: The link reliability from Drone to DDS must have an alternative link for internet connection.

Mechanism: Alternative link for internet connection.

Performance Requirement: DDS must have an alternative link to communicate with Drone.

Physical link: 500 Mbps download and 500 Mbps upload of link speed.

R\_Saf - 166 >> Drone

Cause: Feedback (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) from Drone to DDS is delayed.

Requirement: The feedback from Drone to DDS must have alternative and fast link connection.

Mechanism: Fast processor, fast and alternative link for internet connection.

Performance Requirement: Drone feedback must be processed in real-time.

Physical link: Communication link of DDS must have 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 167 >> DDS

Cause: DDS delays to provide (delayed) the control action: Request flight plan to USS.

Requirement: The communication of DDS to USS must be improved with a fast and reliable link connection.

Mechanism: Fast processor, RAM memory, and fast and reliable link connection.

Performance Requirement: The control action must be provided in less than 1 second.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 168 >> DDS

Cause: USS delays to provide the received control action (Request flight plan) from DDS due to the amount of received requests.

Requirement: The DDS must have an alternative link for send control actions.

Mechanism: Alternative link for internet connection.

Performance Requirement: DDS must have an alternative link to communicate with USS.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 169 >> Drone

Cause: Drone delays to provide the received control action (Back to home) from DDS.

Requirement: DDS must provide the control action in time and use a fast connection.

Mechanism: Reliable hardware and fast connection.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Physical link: The link must have at least 10 Mbps download and 10 Mbps upload of speed.

R\_Saf - 170 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.

Requirement: DDS must have a reliable link, be able to process the feedback in time and provide control actions.

Mechanism: Fast processor and reliable connection.

Performance Requirement: DDS must have a reliable connection and be able to process all

the received feedback.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 171 >> DDS

Cause: DDS does not provide (missing) the control action: Request flight plan to USS.

Requirement: DDS must be able to process the feedback, provide control actions and use reliable protocols.

Mechanism: Fast processor and reliable connection.

Performance Requirement: The communication between DDS and USS must be accomplished in less than 1 second.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 172 >> DDS

Cause: DDS does not provide (missing) the control action: Request flight intentions, Request flight plan or Cancel flight plan; to USS.

Requirement: DDS must be able to process the feedback, provide control actions, use reliable protocols and have reliable link.

Mechanism: Fast processor and reliable connection.

Performance Requirement: The communication between DDS and USS must be accomplished in less than 1 second.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 173 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS algorithm must be projected to operate in specific hardware and have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 174 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines that runs the application.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 175 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to send control actions to the Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

R\_Saf - 176 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to provide control actions to Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

#### R\_Saf - 177 >> USS

Cause: Feedback from USS to DDS (Flight plan status, Flight cancelled or Flight intentions) is missing.

Requirement: DDS must be able to process the USS feedback and use a reliable link.

Mechanism: Reliable or alternative link, and fast processor.

Performance Requirement: The DDS must be available to receive USS feedback 24 hours per day.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

#### R\_Saf - 178 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS hardware must support algorithm upgrades.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Physical link: 500 Mbps download and 500 Mbps upload of speed.

#### R\_Saf - 179 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be tested on emulator and real drone before be approved.

Mechanism:

Performance Requirement: The transmission of the updates of operating must occurs only at the DDS base, using a low range technology.

Physical link: 24 Mbps.

#### R\_Saf - 180 >> Drone

Cause: Feedback from Drone to DDS (Operating system version) is missing.

Requirement: The communication link from Drone to DDS to update the operating system must work in low range.

Mechanism: Bluetooth 4.0.

Performance Requirement: The transmission of the updates of operating must occurs only at the DDS base, using a low range technology.

Physical link: 24 Mbps.

#### R\_Saf - 181 >> DDS

Cause: DDS does not provide (missing) the control action: Update drone system; to Drone.

Requirement: Drone must be in range of DDS bluetooth.

Mechanism: Bluetooth 4.0.

Performance Requirement: The transmission of the updates of operating must occurs only at the DDS base, using a low range technology.

Physical link: 24 Mbps.

### Processor

#### R\_Saf - 182 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must be projected for a specific hardware AND revised AND tested when updated.

Mechanism: Application and operating system with real-time answers.

Performance Requirement: The application must provide the control action in less than 2 seconds.

Processor: Processor must support multithread.

#### R\_Saf - 183 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong due to the delay to process the Drone

feedback. The process model was not updated with current informations.  
Requirement: The process model must be stored in RAM memory during its use.  
Mechanism: More processor, more RAM memory, reliable link and more link speed.  
Performance Requirement: The DDS must have scalable system to receive the Distribution center requisition, USS feedback, and Drone feedback.  
Processor: Dual and scalable processor.

R\_Saf - 184 >> DDS Algorithm/Logic  
Cause: An incorrect DDS Algorithm/Logic was designed.  
Requirement: The DDS Algorithm/Logic must be revised AND tested to provide the control action on time.  
Mechanism: DDS application must run on Virtual Machine.  
Performance Requirement: DDS application must provide the control actions in less than 2 seconds.  
Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 185 >> DDS Algorithm/Logic  
Cause: An incorrect DDS Algorithm/Logic was designed.  
Requirement: The DDS Algorithm/Logic must have low time complexity to provide Start flight on the right time.  
Mechanism: The application must run on Virtual Machine.  
Performance Requirement: DDS application must provide the control actions in less than 2 seconds.  
Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 186 >> USS  
Cause: Feedback from USS to DDS (Flight plan status) is missing.  
Requirement: The communication from USS to DDS must be improved by having reliable connection.  
Mechanism: Reliable link for internet connection.  
Performance Requirement: The link for internet connection must be fast and reliable.  
Processor: Processor with 2 Ghz or higher;

R\_Saf - 187 >> USS  
Cause: Feedback from USS to DDS is delayed.  
Requirement: The feedback from USS to DDS must have alternative link with fast connection.  
Mechanism: Reliable link for internet connection.  
Performance Requirement: The link for internet connection must be fast and reliable.  
Processor: Processor with 2 Ghz or higher;

R\_Saf - 188 >> DDS  
Cause: The DDS does not perform its functions to send control actions and receive feedback.  
Requirement: The DDS must have hardware requirements to normal operation and ongoing analysis after system modification.  
Mechanism: Fast processor, RAM memory, and fast connection.  
Performance Requirement: The RAM memory usage must be under than 60% and resource usage must be under than 80%.  
Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 189 >> DDS  
Cause: DDS delays to provide the control action: Start flight to Drone.  
Requirement: The communication link of DDS to Drone must be improved and the DDS algorithm must have low time complexity.  
Mechanism: Fast and reliable connection.  
Performance Requirement: The system must have a reliable connection or alternative link.  
Processor: Dual and scalable processor with 2.0 GHz or higher.



R\_Saf - 190 >> Weather system

Cause: Weather system is missing.

Requirement: The communication of the external system to DDS must be improved. DDS must have a fast connection and be able to process the Weather information.

Mechanism: Fast link and fast processor.

Performance Requirement: The system must have fast link to receive the information and fast processor to process the information.

Processor: Dual and scalable processor.

R\_Saf - 191 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Fast processor, and RAM memory with less than 60% of use.

Performance Requirement: The average of resource utilization of RAM memory must be 60%.

Processor: Dual and scalable processor with 2.0 GHz or higher the clock.

R\_Saf - 192 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low space complexity, be revised AND tested when updated.

Mechanism: Fast processor and RAM memory.

Performance Requirement: The DDS application must be able to provide the control actions and receive feedback without delay.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 193 >> USS

Cause: Feedback from USS to DDS is delayed.

Requirement: The feedback from USS to DDS must have alternative and fast link connection.

Mechanism: Reliable link for internet connection and fast processor.

Performance Requirement: The link for internet connection must be fast and reliable. The processor must be able to process the feedback.

Processor: Processor with 2.0 Ghz or higher.

R\_Saf - 194 >> DDS

Cause: DDS delays to provide the control action: Back to home to Drone.

Requirement: The communication link of DDS to Drone must be improved and send only the information to controls the Drone.

Mechanism: Fast processor, RAM memory, reliable connection.

Performance Requirement: DDS must provide the control actions in less than 1 second.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 195 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, reliable and fast link connection.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Processor: Dual and scalable processor with 2.0 GHz or higher the clock.

R\_Saf - 196 >> Weather system

Cause: Weather system is missing.

Requirement: The communication link of the external system to DDS must have a fast connection. DDS must be able to process the Weather information.

Mechanism: Reliable link connection and fast processor.

Performance Requirement: The system must have fast link to receive the information and fast processor to process the information.

Processor: Dual and scalable processor.

R\_Saf - 197 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS must be projected to operate in specific hardware and have ongoing analysis after system modification.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time. The application must operate using 60% of RAM memory and less than 80% of system capacity.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 198 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.

Mechanism: Scalable Virtual Machine, fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 199 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must have low complexity and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, reliable and fast link connection.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Processor: Processor must have 2.0 GHz or higher.

R\_Saf - 200 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.

Requirement: DDS must have a reliable link and employ protocols that ensure the message delivery.

Mechanism: Reliable and dedicated link.

Performance Requirement: DDS must have a dedicated connection link to control the drones.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 201 >> Weather system

Cause: Weather system is missing.

Requirement: DDS must have a fast connection to receive the Weather information.

Mechanism: Fast link connection.

Performance Requirement: The system must have fast link to receive the information and fast processor to process the information.

Processor: Dual and scalable processor.

R\_Saf - 202 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS application must be scalable in real-time to send control actions to the drones.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 203 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone and employ protocols that ensure the message delivery.  
Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.  
Performance Requirement: DDS application must be scalable in real-time, the connection link must be fast and have redundancy.  
Processor: Dual and scalable processor with 2.0 GHz or higher.

#### R\_Saf - 204 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.  
Requirement: DDS algorithm must be projected to operate in specific hardware and employ protocols that ensure the message delivery.  
Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.  
Performance Requirement: DDS application must provide the prompt and right answer in less than 1 second.  
Processor: Dual and scalable processor with 2.0 GHz or higher.

#### R\_Saf - 205 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.  
Requirement: DDS must have be able to process the feedback to provide the right control actions, and use a reliable link.  
Mechanism: Fast and reliable connection.  
Performance Requirement: The process model must have priority to be always updated.  
Processor: Dual and scalable processor with 2.0 GHz or higher.

#### R\_Saf - 206 >> Drone

Cause: Feedback from Drone to DDS (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) is missing.  
Requirement: The communication from Drone to DDS must use fast and reliable link, and employ protocols that guarantee the message delivery.  
Mechanism: Reliable connection, fast connection, and HTTP protocol.  
Performance Requirement: The system must be available to receive the Drone feedback.  
Processor: Dual and scalable processor with 2.0 GHz or higher.

#### R\_Saf - 207 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.  
Requirement: DDS algorithm must be projected to operate in specific hardware.  
Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.  
Performance Requirement: DDS application running on a Virtual Machine must never be overloaded.  
Processor: processor with 2.0 GHz or higher.

#### R\_Saf - 208 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position to Drone.  
Requirement: DDS must be able to process the feedback in time to provide the correct control actions and use realible protocols.  
Mechanism: Fast processor, fast connection, and HTTP protocol.  
Performance Requirement: The Virtual machine must have 60% of RAM memory used and 80% of CPU and link being used under normal situation.  
Processor: Dual and scalable processor with 2.0 GHz or higher.

#### R\_Saf - 209 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.  
Requirement: DDS algorithm must employs protocols that ensure the message delivery and be projected to operate in specific hardware.  
Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.  
Performance Requirement: Each Virtual Machine must never be overloaded to provide its

functions.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 210 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.

Requirement: DDS must have a reliable link and be able to process the feedback to provide the right control actions.

Mechanism: Reliable connection and fast processor.

Performance Requirement: DDS must have a fast link and be able to process on time all the control action and feedback.

Processor: Processor with 2.0 GHz or higher.

R\_Saf - 211 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 212 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: The communication of DDS to Drone must be improved. DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, HTTP protocol, and alternative link connection.

Performance Requirement: DDS system must be able to control the number of virtual machines that have the application in real-time and have reliable and fast communication.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 213 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: The algorithm must respect the standardized pattern to communicate with USS.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 214 >> Drone

Cause: Feedback (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status or Returning to base) from Drone to DDS is delayed.

Requirement: The feedback from Drone to DDS must have alternative and fast link connection.

Mechanism: Fast processor, fast and alternative link for internet connection.

Performance Requirement: Drone feedback must be processed in real-time.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 215 >> DDS

Cause: DDS delays to provide (delayed) the control action: Request flight plan to USS.

Requirement: The communication of DDS to USS must be improved with a fast and reliable link connection.

Mechanism: Fast processor, RAM memory, and fast and reliable link connection.

Performance Requirement: The control action must be provided in less than 1 second.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 216 >> DDS Process Model

Cause: Current state of DDS Process Model is wrong.

Requirement: DDS must have a reliable link, be able to process the feedback in time and provide control actions.

Mechanism: Fast processor and reliable connection.

Performance Requirement: DDS must have a reliable connection and be able to process all the received feedback.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 217 >> DDS

Cause: DDS does not provide (missing) the control action: Request flight plan to USS.

Requirement: DDS must be able to process the feedback, provide control actions and use reliable protocols.

Mechanism: Fast processor and reliable connection.

Performance Requirement: The communication between DDS and USS must be accomplished in less than 1 second.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 218 >> DDS

Cause: DDS does not provide (missing) the control action: Request flight intentions, Request flight plan or Cancel flight plan; to USS.

Requirement: DDS must be able to process the feedback, provide control actions, use reliable protocols and have reliable link.

Mechanism: Fast processor and reliable connection.

Performance Requirement: The communication between DDS and USS must be accomplished in less than 1 second.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 219 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS algorithm must be projected to operate in specific hardware and have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 220 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines that runs the application.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 221 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to send control actions to the Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 222 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to provide control actions to Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 223 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: DDS algorithm must run in a specific hardware configuration.

Mechanism: Fast processor, RAM memory and free storage.

Performance Requirement: The resource usage must be under than 80% for each Virtual Machine.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 224 >> USS

Cause: Feedback from USS to DDS (Flight plan status, Flight cancelled or Flight intentions) is missing.

Requirement: DDS must be able to process the USS feedback and use a reliable link.

Mechanism: Reliable or alternative link, and fast processor.

Performance Requirement: The DDS must be available to receive USS feedback 24 hours per day.

Processor: Dual and scalable processor with 2.0 GHz or higher.

R\_Saf - 225 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS hardware must support algorithm upgrades.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Processor: Dual and scalable processor with 2.0 GHz or higher.

## Storage

R\_Saf - 226 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must be revised AND tested to provide the control action on time.

Mechanism: DDS application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 227 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low time complexity to provide Start flight on the right time.

Mechanism: The application must run on Virtual Machine.

Performance Requirement: DDS application must provide the control actions in less than 2 seconds.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 228 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: The DDS Algorithm/Logic must have low space complexity, be revised AND

tested when updated.

Mechanism: Fast processor and RAM memory.

Performance Requirement: The DDS application must be able to provide the control actions and receive feedback without delay.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 229 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must have low complexity and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, reliable and fast link connection.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Storage: At least 50 GB reserved to the application.

R\_Saf - 230 >> DDS Algorithm/Logic

Cause: An incorrect DDS Algorithm/Logic was designed.

Requirement: DDS algorithm must employ protocols that ensure the message delivery and be projected to operate in specific hardware.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: Each Virtual Machine must never be overloaded to provide its functions.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 231 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Storage: Each Virtual Machine must have at least 100GB or more.

R\_Saf - 232 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: The communication of DDS to Drone must be improved. DDS algorithm must be projected to operate in specific hardware and use protocols that guarantee the message delivery.

Mechanism: Fast processor, RAM memory, HTTP protocol, and alternative link connection.

Performance Requirement: DDS system must be able to control the number of virtual machines that have the application in real-time and have reliable and fast communication.

Storage: Each Virtual Machine must have at least 100GB of storage.

R\_Saf - 233 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: The algorithm must respect the standardized pattern to communicate with USS.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: RAM should have less 60% of use and use of resources should be less than 80% in normal operation.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 234 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS algorithm must be projected to operate in specific hardware and have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in

real-time.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 235 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to communicate with drone.

Mechanism: Use several instances of Virtual Machines that runs the application.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 236 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to send control actions to the Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 237 >> DDS

Cause: DDS does not provide (missing) the control action: Go to position; to Drone.

Requirement: DDS must have a dedicated instance of the application to provide control actions to Drone.

Mechanism: Use several instances of Virtual Machines.

Performance Requirement: DDS must be able to manage the number of virtual machines in real-time.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 238 >> DDS Algorithm/Logic

Cause: DDS Algorithm/Logic ineffective after process changes.

Requirement: DDS algorithm must run in a specific hardware configuration.

Mechanism: Fast processor, RAM memory and free storage.

Performance Requirement: The resource usage must be under than 80% for each Virtual Machine.

Storage: Each Virtual Machine must have 100GB of storage.

R\_Saf - 239 >> DDS

Cause: The DDS does not perform its functions to send control actions and receive feedback.

Requirement: The DDS hardware must support algorithm upgrades.

Mechanism: Fast processor, RAM memory, fast connection, and HTTP protocol.

Performance Requirement: DDS must use a fast protocol to send the control actions on time to Drone.

Storage: Each Virtual Machine must have 100GB of storage.

## **Virtual store**

### **Application**

R\_Saf - 240 >> Virtual store Algorithm/Logic

Cause: An incorrect Virtual store Algorithm/Logic was designed which is not able to provide the control action.

Requirement: The Virtual store Algorithm/Logic must be revised AND tested when updated to send the control action immediately to the Device center. Virtual store algorithm must also be



projected to operate in specific hardware.

Mechanism: Reliable operating system, fast processor, fast link, and enough RAM memory.

Performance Requirement: The Virtual store must have scalable computational resources to attend the Customers and Distribution center.

Application: The application must run on the 3 most used internet browsers.

R\_Saf - 241 >> Distribution center

Cause: Feedback from Distribution center to Virtual store is delayed or missing.

Requirement: The feedback from Distribution center to Virtual store must have alternative link or use a protocol that ensure the communication.

Mechanism: Use a reliable and fast protocol.

Performance Requirement: The communication protocol employed by Distribution center to send feedback to Virtual store must ensure the communication and be fast.

Application: Must use HTTP protocol.

R\_Saf - 242 >> Virtual store

Cause: Distribution center does not provide the received control action (Request the period for delivery) from Virtual store.

Requirement: The Distribution center must have ongoing analysis after system modification and employ standardized pattern for send control actions.

Mechanism: Use a JSON file pattern.

Performance Requirement: Virtual store must follow the standard for control actions required by Distribution center.

Application: The application must support JSON files and HTTP communication protocol.

## Interface I/O

R\_Saf - 243 >> Virtual store Algorithm/Logic

Cause: An incorrect Virtual store Algorithm/Logic was designed which is not able to provide the control action.

Requirement: The Virtual store Algorithm/Logic must be revised AND tested when updated to send the control action immediately to the Device center. Virtual store algorithm must also be projected to operate in specific hardware.

Mechanism: Reliable operating system, fast processor, fast link, and enough RAM memory.

Performance Requirement: The Virtual store must have scalable computational resources to attend the Customers and Distribution center.

Interface I/O: The connection must be HPE Ethernet 10/25Gb and 2 ports 10/100/1000.

## Memory

R\_Saf - 244 >> Virtual store Algorithm/Logic

Cause: An incorrect Virtual store Algorithm/Logic was designed which is not able to provide the control action.

Requirement: The Virtual store Algorithm/Logic must be revised AND tested when updated to send the control action immediately to the Device center. Virtual store algorithm must also be projected to operate in specific hardware.

Mechanism: Reliable operating system, fast processor, fast link, and enough RAM memory.

Performance Requirement: The Virtual store must have scalable computational resources to attend the Customers and Distribution center.

Memory: 6 GB of RAM of memory.

## Operating system

R\_Saf - 245 >> Virtual store Algorithm/Logic

Cause: An incorrect Virtual store Algorithm/Logic was designed which is not able to provide the control action.

Requirement: The Virtual store Algorithm/Logic must be revised AND tested when updated to send the control action immediately to the Device center. Virtual store algorithm must also be projected to operate in specific hardware.

Mechanism: Reliable operating system, fast processor, fast link, and enough RAM memory.

Performance Requirement: The Virtual store must have scalable computational resources to attend the Customers and Distribution center.

Operating system: Application must run on Linux based systems.

## Physical link

R\_Saf - 246 >> Virtual store

Cause: Virtual store does not provide (missing) the control action: Request the period for delivery; to Distribution center.

Requirement: The communication of Virtual store to Distribution center must be improved by having an alternative and reliable link.

Mechanism: Virtual store must have an alternative link to communicate with distribution center.

Performance Requirement: The link must have capacity to deal with all the requirements of Distribution center.

Physical link: Each link must have at least 500 Mbps download and 500 Mbps upload speed.

## Processor

R\_Saf - 247 >> Virtual store Algorithm/Logic

Cause: An incorrect Virtual store Algorithm/Logic was designed which is not able to provide the control action.

Requirement: The Virtual store Algorithm/Logic must be revised AND tested when updated to send the control action immediately to the Device center. Virtual store algorithm must also be projected to operate in specific hardware.

Mechanism: Reliable operating system, fast processor, fast link, and enough RAM memory.

Performance Requirement: The Virtual store must have scalable computational resources to attend the Customers and Distribution center.

Processor: Support dual and scalable processor.

## Storage

R\_Saf - 248 >> Virtual store Algorithm/Logic

Cause: An incorrect Virtual store Algorithm/Logic was designed which is not able to provide the control action.

Requirement: The Virtual store Algorithm/Logic must be revised AND tested when updated to send the control action immediately to the Device center. Virtual store algorithm must also be projected to operate in specific hardware.

Mechanism: Reliable operating system, fast processor, fast link, and enough RAM memory.

Performance Requirement: The Virtual store must have scalable computational resources to attend the Customers and Distribution center.

Storage: Must have at least 2 TB of storage.

## Drone

### Application

## Interface I/O

R\_Saf - 249 >> Cellular network positioning

Cause: Cellular network positioning is wrong or missing.

Requirement: The communication of the external system to Drone must be improved by using the GPS and cellphone network connection.

Mechanism: GPS and Cellphone network connection.

Performance Requirement: Drone must always use the A-GPS to improve the accuracy of positioning.

Interface I/O: GPS and 4G Cellphone network connection.

R\_Saf - 250 >> GPS positioning

Cause: GPS positioning is wrong or missing.

Requirement: The communication of the external system to Drone must be improved by using the GPS combined with cellphone network connection.

Mechanism: A-GPS.

Performance Requirement: Drone must combine the positioning from GPS with cellphone network positioning.

Interface I/O: GPS connection and cellphone network connection and supporting A-GPS.

R\_Saf - 251 >> Cellular network positioning

Cause: Cellular network positioning is missing.

Requirement: The communication of the external system to Drone must be improved by using an alternative way to connect with cellphone network.

Mechanism: Alternative cellphone connection.

Performance Requirement: Drone may have an alternative cellphone connection with the same capacity of primary.

Interface I/O: Alternative cellphone network connection.

R\_Saf - 252 >> GPS positioning

Cause: GPS positioning is not accurate.

Requirement: Drone must use reliable GPS systems to improve location accuracy, such as BeiDou and Galileo GPS.

Mechanism: GPS compatible with BeiDou and Galileo GPS and use the A-GPS positioning.

Performance Requirement: The GPS signal must have an accuracy of 10 meters or lower.

Interface I/O: Cellphone network connection and GPS connection and supporting A-GPS.

## Memory

R\_Saf - 253 >> Drone Algorithm/Logic

Cause: An incorrect Drone operating system was designed.

Requirement: The Drone operating system must be revised and tested using the emulator several times and with different scenarios when updated.

Mechanism: RTOS operating system, fast processor, and free RAM memory.

Performance Requirement: Drone operating system must be able to provide the control action in less than 1 second.

Memory: 1 GB of RAM memory.

R\_Saf - 254 >> Drone Process Model

Cause: Current state of Drone Process Model is wrong.

Requirement: The process model of Drone must be in the RAM memory during its use.

Mechanism: RTOS operating system, fast processor, free RAM memory, and fast communication protocol.

Performance Requirement: Drone must be able to process the received feedback in less than 1 second.

Memory: 1 GB of RAM memory.

R\_Saf - 255 >> Distance sensor

Cause: Feedback of Distance sensor is missing.

Requirement: The Distance sensor must be maintained when time of use == 3 months.

Mechanism: Fast processor and free memory.

Performance Requirement: Drone must have free memory to receive the feedback and have a fast processor to receive the feedback.

Memory: 1 GB of RAM memory.

R\_Saf - 256 >> Compartment actuator

Cause: Compartment actuator did not receive the control action, from Drone, or cannot act (not executed) in Delivery process.

Requirement: The Compartment actuator must be reliable and have periodic maintenance (each month).

Mechanism: RTOS operating system, fast processor, free RAM memory, and fast communication protocol.

Performance Requirement: Drone must provide the control action in less than 1 second.

Memory: 1 GB of RAM memory.

R\_Saf - 257 >> Drone

Cause: The Drone controller does not perform its functions to send control actions and receive feedback.

Requirement: Drone must be projected with a minimum hardware requirements, have a hundred hours of emulator test and a hundred hours of normal test.

Mechanism: RTOS operating system, processor, free RAM memory, and fast communication protocol.

Performance Requirement: Drone must be able to process the feedback and provide the control action in less than 1 second.

Memory: 1 GB of RAM memory.

R\_Saf - 258 >> Drone Algorithm/Logic

Cause: Drone Algorithm/Logic became ineffective after process changes.

Requirement: DDS must use a real-time operating system that has efficient task scheduling and memory management. DDS must use a processor compatible with the real-time operating system.

Mechanism: The chosen RTOS operating system is RTOS4Drone. The processor is P4Drone which has a processor speed 1.0GHz and memory size of 512MB.

Performance Requirement: Drone must use a real-time operating system with a task scheduler that can prioritize the issuance of the control action release package. Drone's processing unit must have enough memory to store the operating system variables, sensor feedback measures, and free memory to consider a system upgrade. The processor must have 1.0GHz or higher speed.

Memory: Memory Drone must have 512 MB of RAM memory or more.

R\_Saf - 259 >> Camera

Cause: Feedback of Camera is missing.

Requirement: The Camera must be maintained when time of use == 1 week.

Mechanism: RAM memory and storage.

Performance Requirement: Drone must have 40% of RAM memory and storage free to use to process the camera image.

Memory: 1 GB of RAM memory.

R\_Saf - 260 >> Distance sensor

Cause: Feedback of Distance sensor is missing.

Requirement: The Distance sensor must be maintained when time of use == 1 month.

Mechanism: Free RAM memory and free storage memory.

Performance Requirement: The distance sensor must be processed in real-time.

Memory: 1 GB of RAM memory.

R\_Saf - 261 >> Compartment actuator

Cause: The issued control action delays to be enforced by the Compartment actuator.

Requirement: The Compartment actuator must be reliable and have periodic maintenance (each month).

Mechanism: RTOS operating system, fast processor, and free memory.

Performance Requirement: The Drone hardware usage must be under 60%.

Memory: 1 GB of RAM memory.

## Operating system

R\_Saf - 262 >> Drone Algorithm/Logic

Cause: An incorrect Drone operating system was designed.

Requirement: The Drone operating system must be revised and tested using the emulator several times and with different scenarios when updated.

Mechanism: RTOS operating system, fast processor, and free RAM memory.

Performance Requirement: Drone operating system must be able to provide the control action in less than 1 second.

Operating system: Drone operating system is the real-time operating system System B.

R\_Saf - 263 >> Drone Process Model

Cause: Current state of Drone Process Model is wrong.

Requirement: The process model of Drone must be in the RAM memory during its use.

Mechanism: RTOS operating system, fast processor, free RAM memory, and fast communication protocol.

Performance Requirement: Drone must be able to process the received feedback in less than 1 second.

Operating system: Drone operating system is the real-time operating system LynxOS 7.0. The operating system must support HTTP protocol.

R\_Saf - 264 >> Cellular network positioning

Cause: Cellular network positioning is wrong or missing.

Requirement: The communication of the external system to Drone must be improved by using the GPS and cellphone network connection.

Mechanism: GPS and Cellphone network connection.

Performance Requirement: Drone must always use the A-GPS to improve the accuracy of positioning.

Operating system: The operating system must support cellphone network connection.

R\_Saf - 265 >> GPS positioning

Cause: GPS positioning is wrong or missing.

Requirement: The communication of the external system to Drone must be improved by using the GPS combined with cellphone network connection.

Mechanism: A-GPS.

Performance Requirement: Drone must combine the positioning from GPS with cellphone network positioning.

Operating system: The operating system must support cellphone network connection, GPS connection and AGPS technology.

R\_Saf - 266 >> Compartment actuator

Cause: Compartment actuator did not received the control action, from Drone, or cannot act (not executed) in Delivery process.

Requirement: The Compartment actuator must be reliable and have periodic maintenance (each month).

Mechanism: RTOS operating system, fast processor, free RAM memory, and fast communication protocol.

Performance Requirement: Drone must provide the control action in less than 1 second.

Operating system: Drone operating system is the real-time operating system LynxOS 7.0. The operating system must support HTTP protocol.

R\_Saf - 267 >> Drone

Cause: The Drone controller does not perform its functions to send control actions and receive feedback.

Requirement: Drone must be projected with a minimu hardware requirements, have a hundred hours of emulator test and a hundred hours of normal test.

Mechanism: RTOS operating system, processor, free RAM memory, and fast communication protocol.

Performance Requirement: Drone must be able to process the feedback and provide the control action in less than 1 second.

Operating system: Drone operating system is the real-time operating system LynxOS 7.0. The operating system must support HTTP protocol.

R\_Saf - 268 >> Compartment actuator

Cause: Drone does not provide (missing) control action: Release package to Compartment actuator.

Requirement: Drone system must be projected to operate in a specific hardware.

Mechanism: RTOS operating system, fast processor, fast communication protocol, and fast storage.

Performance Requirement: Drone must be able to receive the feedback, read the storage, process the information, and provide the control action in less than 1 second.

Operating system: Drone operating system is the real-time operating system LynxOS 7.0. The operating system must support HTTP protocol.

R\_Saf - 269 >> Drone Algorithm/Logic

Cause: Drone Algorithm/Logic became ineffective after process changes.

Requirement: DDS must use a real-time operating system that has efficient task scheduling and memory management. DDS must use a processor compatible with the real-time operating system.

Mechanism: The chosen RTOS operating system is RTOS4Drone. The processor is P4Drone which has a processor speed 1.0GHz and memory size of 512MB.

Performance Requirement: Drone must use a real-time operating system with a task scheduler that can prioritize the issuance of the control action release package. Drone's processing unit must have enough memory to store the operating system variables, sensor feedback measures, and free memory to consider a system upgrade. The processor must have 1.0GHz or higher speed.

Operating system: Drone operating system is the RTOS4Drone.

R\_Saf - 270 >> Camera

Cause: Temporary obstruction does not allow the reading of the Delivery process by Camera.

Requirement: The Camera shall have alternative way to read the QR-Code of customer.

Mechanism: Fast processor and RTOS4Drone operating system.

Performance Requirement: The camera image must be processed in real-time.

Operating system: Drone operating system is the real-time operating system LynxOS 7.0.

R\_Saf - 271 >> Distance sensor

Cause: Temporary obstruction does not allow the reading of the Delivery process by Distance

sensor.

Requirement: The Distance sensor shall have alternative way to read Delivery process, and must be maintained weekly.

Mechanism: Alternative sensor.

Performance Requirement: The Drone operating system must be able to identify sensor problems and change to the alternative sensor.

Operating system: Support multiple distance sensor.

R\_Saf - 272 >> GPS positioning

Cause: GPS positioning is not accurate.

Requirement: Drone must use reliable GPS systems to improve location accuracy, such as BeiDou and Galileo GPS.

Mechanism: GPS compatible with BeiDou and Galileo GPS and use the A-GPS positioning.

Performance Requirement: The GPS signal must have an accuracy of 10 meters or lower.

Operating system: Support A-GPS.

R\_Saf - 273 >> Compartment actuator

Cause: The issued control action delays to be enforced by the Compartment actuator.

Requirement: The Compartment actuator must be reliable and have periodic maintenance (each month).

Mechanism: RTOS operating system, fast processor, and free memory.

Performance Requirement: The Drone hardware usage must be under 60%.

Operating system: Drone operating system is the real-time operating system LynxOS 7.0.

R\_Saf - 274 >> Package sensor

Cause: Feedback (Package status) lost or corrupted.

Requirement: The Package sensor of Drone must have a reliable sensor or alternative sensor.

Mechanism: Fast processor, RTOS operating system, and alternative or reliable sensor.

Performance Requirement: Drone must be able to compute the feedback and provide the control action in the right time.

Operating system: Drone operating system is the real-time operating system LynxOS 7.0.

R\_Saf - 275 >> Compartment actuator

Cause: The Compartment actuator does not perform its functions to perform the control action.

Requirement: The Compartment actuator must have ongoing analysis after system modification and have several hours of testing in the emulator and using a real drone.

Mechanism: Fast processor and RTOS operating system.

Performance Requirement: Drone must be able to compute the feedback and provide the control action in the right time.

Operating system: Drone operating system is the real-time operating system LynxOS 7.0.

## Physical link

R\_Saf - 276 >> Cellular network positioning

Cause: Cellular network positioning is wrong or missing.

Requirement: The communication of the external system to Drone must be improved by using the GPS and cellphone network connection.

Mechanism: GPS and Cellphone network connection.

Performance Requirement: Drone must always use the A-GPS to improve the accuracy of positioning.

Physical link: 4G connection.

R\_Saf - 277 >> GPS positioning

Cause: GPS positioning is wrong or missing.

Requirement: The communication of the external system to Drone must be improved by using the GPS combined with cellphone network connection.

Mechanism: A-GPS.

Performance Requirement: Drone must combine the positioning from GPS with cellphone network positioning.

Physical link: 4G connection for cellphone network and glonass for GPS.

R\_Saf - 278 >> Cellular network positioning

Cause: Cellular network positioning is missing.

Requirement: The communication of the external system to Drone must be improved by using an alternative way to connect with cellphone network.

Mechanism: Alternative cellphone connection.

Performance Requirement: Drone may have an alternative cellphone connection with the same capacity of primary.

Physical link: 4G connection.

R\_Saf - 279 >> GPS positioning

Cause: GPS positioning is not accurate.

Requirement: Drone must use reliable GPS systems to improve location accuracy, such as BeiDou and Galileo GPS.

Mechanism: GPS compatible with BeiDou and Galileo GPS and use the A-GPS positioning.

Performance Requirement: The GPS signal must have an accuracy of 10 meters or lower.

Physical link: The drone must have a 4G connection to cellphone network and GPS compatible with Glonass, BeiDou and Galileo.

## Processor

R\_Saf - 280 >> Drone Algorithm/Logic

Cause: An incorrect Drone operating system was designed.

Requirement: The Drone operating system must be revised and tested using the emulator several times and with different scenarios when updated.

Mechanism: RTOS operating system, fast processor, and free RAM memory.

Performance Requirement: Drone operating system must be able to provide the control action in less than 1 second.

Processor: Processor quad-core with 1.0 Ghz.

R\_Saf - 281 >> Drone Process Model

Cause: Current state of Drone Process Model is wrong.

Requirement: The process model of Drone must be in the RAM memory during its use.

Mechanism: RTOS operating system, fast processor, free RAM memory, and fast communication protocol.

Performance Requirement: Drone must be able to process the received feedback in less than 1 second.

Processor: Processor quad-core with 1.0 Ghz.

R\_Saf - 282 >> Distance sensor

Cause: Current state of the Delivery process cannot be read accurately by Distance sensor.

Requirement: The Distance sensor must have accuracy == 5cm.

Mechanism: Fast processor.

Performance Requirement: Drone must be able to process the feedback in less than 1 second.

Processor: Processor quad-core with 1.0 Ghz.

R\_Saf - 283 >> Distance sensor

Cause: Feedback of Distance sensor is missing.



Requirement: The Distance sensor must be maintained when time of use == 3 months.  
Mechanism: Fast processor and free memory.  
Performance Requirement: Drone must have free memory to receive the feedback and have a fast processor to received the feedback.  
Processor: Processor quad-core with 1.0 Ghz.

R\_Saf - 284 >> Compartment actuator  
Cause: Compartment actuator did not received the control action, from Drone, or cannot act (not executed) in Delivery process.  
Requirement: The Compartment actuator must be reliable and have periodic maintenance (each month).  
Mechanism: RTOS operating system, fast processor, free RAM memory, and fast communication protocol.  
Performance Requirement: Drone must provide the control action in less than 1 second.  
Processor: Processor quad-core with 1.0 Ghz.

R\_Saf - 285 >> Drone  
Cause: The Drone controller does not perform its functions to send control actions and receive feedback.  
Requirement: Drone must be projected with a minimu hardware requirements, have a hundred hours of emulator test and a hundred hours of normal test.  
Mechanism: RTOS operating system, processor, free RAM memory, and fast communication protocol.  
Performance Requirement: Drone must be able to process the feedback and provide the control action in less than 1 second.  
Processor: Quad-core processor with 1.0 GHz.

R\_Saf - 286 >> Compartment actuator  
Cause: Drone does not provide (missing) control action: Release package to Compartment actuator.  
Requirement: Drone system must be projected to operate in a specific hardware.  
Mechanism: RTOS operating system, fast processor, fast communication protocol, and fast storage.  
Performance Requirement: Drone must be able to receive the feeback, read the storage, process the information, and provide the control action in less than 1 second.  
Processor: Processor quad-core with 1.0 Ghz.

R\_Saf - 287 >> Drone Algorithm/Logic  
Cause: Drone Algorithm/Logic became ineffective after process changes.  
Requirement: DDS must use a real-time operating system that has efficient task scheduling and memory management. DDS must use a processor compatible with the real-time operating system.  
Mechanism: The chosen RTOS operating system is RTOS4Drone. The processor is P4Drone which has a processor speed 1.0GHz and memory size of 512MB.  
Performance Requirement: Drone must use a real-time operating system with a task scheduler that can prioritize the issuance of the control action release package. Drone's processing unit must have enough memory to store the operating system variables, sensor feedback measures, and free memory to consider a system upgrade. The processor must have 1.0GHz or higher speed.  
Processor: Processor The processor is P4Drone with 1.0GHz of speed.

R\_Saf - 288 >> Camera  
Cause: Temporary obstruction does not allow the reading of the Delivery process by Camera.  
Requirement: The Camera shall have alternative way to read the QR-Code of customer.  
Mechanism: Fast processor and RTOS4Drone operating system.  
Performance Requirement: The camera image must be processed in real-time.

Processor: Processor quad-core with 1.0 Ghz.

R\_Saf - 289 >> Compartment actuator

Cause: The issued control action delays to be enforced by the Compartment actuator.

Requirement: The Compartment actuator must be reliable and have periodic maintenance (each month).

Mechanism: RTOS operating system, fast processor, and free memory.

Performance Requirement: The Drone hardware usage must be under 60%.

Processor: Processor quad-core with 1.0 Ghz.

R\_Saf - 290 >> Package sensor

Cause: Feedback (Package status) lost or corrupted.

Requirement: The Package sensor of Drone must have a reliable sensor or alternative sensor.

Mechanism: Fast processor, RTOS operating system, and alternative or reliable sensor.

Performance Requirement: Drone must be able to compute the feedback and provide the control action in the right time.

Processor: Processor quad-core with 1.0 Ghz or higher.

R\_Saf - 291 >> Compartment actuator

Cause: The Compartment actuator does not perform its functions to perform the control action.

Requirement: The Compartment actuator must have ongoing analysis after system modification and have several hours of testing in the emulator and using a real drone.

Mechanism: Fast processor and RTOS operating system.

Performance Requirement: Drone must be able to compute the feedback and provide the control action in the right time.

Processor: Processor quad-core with 1.0 Ghz or higher.

## Storage

R\_Saf - 292 >> Drone Process Model

Cause: Current state of Drone Process Model is wrong.

Requirement: The process model of Drone must be in the RAM memory during its use.

Mechanism: RTOS operating system, fast processor, free RAM memory, and fast communication protocol.

Performance Requirement: Drone must be able to process the received feedback in less than 1 second.

Storage: 64 GB of storage.

R\_Saf - 293 >> Compartment actuator

Cause: Drone does not provide (missing) control action: Release package to Compartment actuator.

Requirement: Drone system must be projected to operate in a specific hardware.

Mechanism: RTOS operating system, fast processor, fast communication protocol, and fast storage.

Performance Requirement: Drone must be able to receive the feedback, read the storage, process the information, and provide the control action in less than 1 second.

Storage: 64 GB of storage with 300 MB of write speed (or higher) and 300 MB of read speed (or higher).

R\_Saf - 294 >> Camera

Cause: Feedback of Camera is missing.

Requirement: The Camera must be maintained when time of use == 1 week.

Mechanism: RAM memory and storage.

Performance Requirement: Drone must have 40% of RAM memory and storage free to use to process the camera image.

Storage: 64 GB of storage.

R\_Saf - 295 >> Distance sensor

Cause: Feedback of Distance sensor is missing.

Requirement: The Distance sensor must be maintained when time of use == 1 month.

Mechanism: Free RAM memory and free storage memory.

Performance Requirement: The distance sensor must be processed in real-time.

Storage: 64 GB or higher.

## Security

### Distribution center

#### Application

R\_Sec - 1 >> Spoofing (Priority: High)

Cause: Distribution center may be spoofed by an attacker and this may lead to information disclosure by Virtual store.

Requirement: Distribution center must have authenticated and secure channel for data received.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol used by Distribution center system must never delay the processing of information due to encryption.

Application: The application must support HTTPS, SSL/TLS.

R\_Sec - 2 >> Repudiation (Priority: High)

Cause: Distribution center claims that it did not receive data (Request the period for delivery).

Requirement: Distribution center must have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The logging of all control actions and feedback of Distribution center must be fast and be stored for 10 years.

Application: The application must support Log4j 2.

R\_Sec - 3 >> Spoofing (Priority: High)

Cause: Distribution center may be spoofed by an attacker and this may lead to information disclosure by DDS.

Requirement: Distribution center must have authentication for data received.

Mechanism: Use asymmetric cryptography as a second way of authentication.

Performance Requirement: The authentication process of Distribution center must take less than 1 second.

Application: Application must support HTTPS.

R\_Sec - 4 >> Repudiation (Priority: High)

Cause: Distribution center claims that it did not receive data (Request status, Delivery status, List of periods).

Requirement: Distribution center must have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The logging of all control actions and feedback received or sent by Distribution center must be fast and be stored for 10 years.

Application: Application must support Log4j 2.

R\_Sec - 5 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Distribution center, or an information disclosure by Virtual store -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Distribution center must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Application: The application must support HTTPS and have an authentication method based on user + password.

R\_Sec - 6 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Distribution center must have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Application: The application must support HTTPS.

R\_Sec - 7 >> Denial of service (Priority: High)

Cause: Virtual store -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Virtual store -> Distribution center shall have appropriated authentication, have a filtering with rate limit, and replication for data flow.

Mechanism: The Distribution center must have alternative links and use VM. The authentications is assymetric. The Distribution center filter must accept only valid JSON files. The rate limit must limit the connections through firewall.

Performance Requirement: The validation process of Distribution center must take less than 1 second.

Application: Must support multiple instances and JSON files standard.

R\_Sec - 8 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Distribution center -> Virtual store, or an information disclosure by Distribution center -> Virtual store. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Distribution center -> Virtual store must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The encryption for Distribution center must not delay the communication Delivery center system and Virtual store.

Application: The application must support HTTPS with SSL/TLS.

R\_Sec - 9 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by

an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Distribution center -> Virtual store must have data encryption for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The encryption for Distribution center must not delay the communication Delivery center system and Virtual store.

Application: The application must support HTTPS with SSL/TLS.

#### R\_Sec - 10 >> Denial of service (Priority: High)

Cause: Distribution center -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> Virtual store must have appropriated replication, authentication, and filtering with rate limit for data flow.

Mechanism: The Virtual store must have alternative links. The authentications is assymetric. The Virtual store filter must accept only valid JSON files. The rate limit must limit the connections through firewall. The replication must use VM.

Performance Requirement: The Virtual store must be able to accomplish the validation process of the Distribution center in less than 1 second.

Application: Application must support HTTPS, JSON files and replication.

#### R\_Sec - 11 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Distribution center, or an information disclosure by DDS -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Distribution center must have data encryption or tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Application: The application must support HTTPS.

#### R\_Sec - 12 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Distribution center must have data encryption for data flow.

Mechanism: The data encryption is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Application: The application must support HTTPS.

#### R\_Sec - 13 >> Denial of service (Priority: High)

Cause: DDS -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> Distribution center must have appropriated authentication, and filtering with rate limit, and replication for data flow.

Mechanism: Distribution center must use assymetric encryption as a second way for authentication. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. The replication must use VM.

Performance Requirement: Distribution center must be able to accomplish the validation process of DDS feedback in less than 1 second.

Application: Application must support assymmetric encryption, JSON files and replication.

R\_Sec - 14 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight plans, Request a flight plan, Cancel a flight, Request status may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Distribution center -> DDS must have data encryption, use privacy-enhanced protocols, and protect the secrets for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Application: The application must support HTTPS.

R\_Sec - 15 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Application: DDS application must support replication.

## Interface I/O

## Memory

R\_Sec - 16 >> Denial of service (Priority: High)

Cause: Distribution center -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> Virtual store must have appropriated replication, authentication, and filtering with rate limit for data flow.

Mechanism: The Virtual store must have alternative links. The authentications is assymmetric. The Virtual store filter must accept only valid JSON files. The rate limit must limit the connections through firewall. The replication must use VM.

Performance Requirement: The Virtual store must be able to accomplish the validation process of the Distribution center in less than 1 second.

Memory: Virtual store must have 8 GB or more.

R\_Sec - 17 >> Denial of service (Priority: High)

Cause: DDS -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> Distribution center must have appropriated authentication, and filtering with rate limit, and replication for data flow.

Mechanism: Distribution center must use assymmetric encryption as a second way for authentication. Firewall IPTables to filter the input to accept only JSON files, and limit the number of requisitions. The replication must use VM.

Performance Requirement: Distribution center must be able to accomplish the validation

process of DDS feedback in less than 1 second.

Memory: Each Virtual Machine of Distribution center must have 8 GB or more.

R\_Sec - 18 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Memory: Each Virtual Machine of DDS must have 8 GB of RAM memory or higher.

## Operating system

R\_Sec - 19 >> Denial of service (Priority: High)

Cause: Virtual store -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Virtual store -> Distribution center shall have appropriated authentication, have a filtering with rate limit, and replication for data flow.

Mechanism: The Distribution center must have alternative links and use VM. The authentications is assymetric. The Distribution center filter must accept only valid JSON files. The rate limit must limit the connections through firewall.

Performance Requirement: The validation process of Distribution center must take less than 1 second.

Operating system: The operating system is Linux based operating system and must support the use of Virtual Machines and have a firewall.

R\_Sec - 20 >> Denial of service (Priority: High)

Cause: Distribution center -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> Virtual store must have appropriated replication, authentication, and filtering with rate limit for data flow.

Mechanism: The Virtual store must have alternative links. The authentications is assymetric. The Virtual store filter must accept only valid JSON files. The rate limit must limit the connections through firewall. The replication must use VM.

Performance Requirement: The Virtual store must be able to accomplish the validation process of the Distribution center in less than 1 second.

Operating system: Must have a firewall to limit the communication to JSON files and limit the connection intentions.

R\_Sec - 21 >> Denial of service (Priority: High)

Cause: DDS -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> Distribution center must have appropriated authentication, and filtering with rate limit, and replication for data flow.

Mechanism: Distribution center must use assymetric encryption as a second way for authentication. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. The replication must use VM.

Performance Requirement: Distribution center must be able to accomplish the validation process of DDS feedback in less than 1 second.

Operating system: Must have a firewall to limit the communication to JSON files and limit the connection intentions.

R\_Sec - 22 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Operating system: Linux based with long-term support.

## Physical link

R\_Sec - 23 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Distribution center, or an information disclosure by Virtual store -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Distribution center must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Physical link: Must have 10 Mbps upload and 10 Mbps download of speed or higher.

R\_Sec - 24 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker.

Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Distribution center must have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Physical link: Must have 10 Mbps upload and 10 Mbps download of speed or higher.

R\_Sec - 25 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Distribution center, or an information disclosure by DDS -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Distribution center must have data encryption or tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Physical link: The minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.



R\_Sec - 26 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Distribution center must have data encryption for data flow.

Mechanism: The data encryption is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Physical link: The minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

R\_Sec - 27 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight plans, Request a flight plan, Cancel a flight, Request status may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Distribution center -> DDS must have data encryption, use privacy-enhanced protocols, and protect the secrets for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Physical link: The minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

## Processor

R\_Sec - 28 >> Spoofing (Priority: High)

Cause: Distribution center may be spoofed by an attacker and this may lead to information disclosure by DDS.

Requirement: Distribution center must have authentication for data received.

Mechanism: Use asymmetric cryptography as a second way of authentication.

Performance Requirement: The authentication process of Distribution center must take less than 1 second.

Processor: Processor must have 1.6 Ghz or more of clock.

R\_Sec - 29 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Distribution center, or an information disclosure by Virtual store -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Distribution center must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Processor: Processor must have 1.4 Ghz or higher.

R\_Sec - 30 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Distribution center must have data encryption for data flow.  
Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Processor: Processor must have 1.4 Ghz or higher.

#### R\_Sec - 31 >> Denial of service (Priority: High)

Cause: Distribution center -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> Virtual store must have appropriated replication, authentication, and filtering with rate limit for data flow.

Mechanism: The Virtual store must have alternative links. The authentications is assymetric. The Virtual store filter must accept only valid JSON files. The rate limit must limit the connections through firewall. The replication must use VM.

Performance Requirement: The Virtual store must be able to accomplish the validation process of the Distribution center in less than 1 second.

Processor: Must have 1.8 Ghz or higher.

#### R\_Sec - 32 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Distribution center, or an information disclosure by DDS -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Distribution center must have data encryption or tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 33 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Distribution center must have data encryption for data flow.

Mechanism: The data encryption is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 34 >> Denial of service (Priority: High)

Cause: DDS -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> Distribution center must have appropriated authentication, and filtering with rate limit, and replication for data flow.

Mechanism: Distribution center must use assymetric encryption as a second way for authentication. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. The replication must use VM.

Performance Requirement: Distribution center must be able to accomplish the validation process of DDS feedback in less than 1 second.

Processor: Must have 1.8 GHz or higher.

R\_Sec - 35 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight plans, Request a flight plan, Cancel a flight, Request status may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Distribution center -> DDS must have data encryption, use privacy-enhanced protocols, and protect the secrets for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Processor: Processor must have at least 1.6 Ghz.

R\_Sec - 36 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Processor: Must have 1.8 GHz or higher.

## Storage

R\_Sec - 37 >> Repudiation (Priority: High)

Cause: Distribution center claims that it did not receive data (Request the period for delivery).

Requirement: Distribution center must have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The logging of all control actions and feedback of Distribution center must be fast and be stored for 10 years.

Storage: The storage is 2TB or higher.

R\_Sec - 38 >> Repudiation (Priority: High)

Cause: Distribution center claims that it did not receive data (Request status, Delivery status, List of periods).

Requirement: Distribution center must have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The logging of all control actions and feedback received or sent by Distribution center must be fast and be stored for 10 years.

Storage: The Storage is 2TB or higher.

R\_Sec - 39 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Storage: 750 GB or higher.

## Customer

### Application

#### R\_Sec - 40 >> Spoofing (Priority: High)

Cause: Customer may be spoofed by an attacker and this may lead to information disclosure by Virtual store.

Requirement: Customer must/shall have secure channel for data received.

Mechanism: The secure channel is HTTPS which uses SSL/TLS.

Performance Requirement: The encryption must not delay the communication between Virtual store to the Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS and SSL/TLS.

#### R\_Sec - 41 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Customer -> Virtual store, or an information disclosure by Customer -> Virtual store. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Customer -> Virtual store must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The mechanism is HTTPS protocol for communication.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS.

#### R\_Sec - 42 >> Denial of service (Priority: High)

Cause: Customer -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Customer -> Virtual store must/shall have appropriated authentication, have rate limit with filtering, and have replication for data flow.

Mechanism: The authentication is user+password. Virtual store must limit the connections from Customer with a firewall. The filtering must accept only valid JSON files. The replication must use VM.

Performance Requirement: Virtual store system must be able to accomplish the authentication process in less than 1 second.

Application: Must have a validation for user and password, accept only JSON files and support replication.

#### R\_Sec - 43 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Customer, or an information disclosure by Virtual store -> Customer. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Customer must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS.

#### R\_Sec - 44 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by

an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Customer must/shall data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS.

R\_Sec - 45 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker.

Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Customer -> Virtual store must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS.

## Interface I/O

## Memory

## Operating system

R\_Sec - 46 >> Denial of service (Priority: High)

Cause: Customer -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Customer -> Virtual store must/shall have appropriated authentication, have rate limit with filtering, and have replication for data flow.

Mechanism: The authentication is user+password. Virtual store must limit the connections from Customer with a firewall. The filtering must accept only valid JSON files. The replication must use VM.

Performance Requirement: Virtual store system must be able to accomplish the authentication process in less than 1 second.

Operating system: Virtual store operating system must have have replication of the application and have a firewall.

## Physical link

R\_Sec - 47 >> Spoofing (Priority: High)

Cause: Customer may be spoofed by an attacker and this may lead to information disclosure by Virtual store.

Requirement: Customer must/shall have secure channel for data received.

Mechanism: The secure channel is HTTPS which uses SSL/TLS.

Performance Requirement: The encryption must not delay the communication between Virtual store to the Customer. It must be accomplished in less than 1 second.

Physical link: The connection link for Customer must have at least 5 Mbps download and 5

Mbps upload of speed.

## Processor

### R\_Sec - 48 >> Spoofing (Priority: High)

Cause: Customer may be spoofed by an attacker and this may lead to information disclosure by Virtual store.

Requirement: Customer must/shall have secure channel for data received.

Mechanism: The secure channel is HTTPS which uses SSL/TLS.

Performance Requirement: The encryption must not delay the communication between Virtual store to the Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

### R\_Sec - 49 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Customer -> Virtual store, or an information disclosure by Customer -> Virtual store. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Customer -> Virtual store must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The mechanism is HTTPS protocol for communication.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

### R\_Sec - 50 >> Denial of service (Priority: High)

Cause: Customer -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Customer -> Virtual store must/shall have appropriated authentication, have rate limit with filtering, and have replication for data flow.

Mechanism: The authentication is user+password. Virtual store must limit the connections from Customer with a firewall. The filtering must accept only valid JSON files. The replication must use VM.

Performance Requirement: Virtual store system must be able to accomplish the authentication process in less than 1 second.

Processor: Processor must have 1.6 Ghz or higher.

### R\_Sec - 51 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Customer, or an information disclosure by Virtual store -> Customer. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Customer must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

### R\_Sec - 52 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance

violations.

Requirement: Link Virtual store -> Customer must/shall data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

R\_Sec - 53 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker.

Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Customer -> Virtual store must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

## Storage

## DDS

## Application

R\_Sec - 54 >> Spoofing (Priority: High)

Cause: DDS may be spoofed by an attacker and this may lead to information disclosure by Weather system.

Requirement: DDS must/shall have authentication for data received.

Mechanism: The communication must employ SSL/TLS certificate.

Performance Requirement: DDS application must authenticate each connection in real-time.

Application: Application must support SSL/TLS.

R\_Sec - 55 >> Spoofing (Priority: High)

Cause: DDS may be spoofed by an attacker and this may lead to information disclosure by USS or make DDS believes that a flight plan is approved or not.

Requirement: DDS must/shall have authenticated and secured channel for data received.

Mechanism: The communication with SSL/TLS.

Performance Requirement: Each communication must be authenticated and sent in secure channel on real-time.

Application: Application must support SSL/TLS.

R\_Sec - 56 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, have filtering with rate limit, and replication for data received.

Mechanism: The authentication is SSL/TLS. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. DDS must have a replication of service.

Performance Requirement: The firewall must be work all the time, and each request must take 1 second until 1 second to be answered.

Application: Application must support SSL/TLS. Each instance of application must be running on a Virtual Machine.

R\_Sec - 57 >> Elevation of privilege (Priority: High)

Cause: DDS may be able to impersonate the context of DDS in order to gain additional privilege. An attacker may pass data into USS in order to change the flow of program execution within DDS to the attacker's choosing. USS may be able to remotely execute code for DDS.

Requirement: DDS must/shall have restrict inputs for data received.

Mechanism: The restriction must accept only valid JSON files.

Performance Requirement: The system must validate each JSON file before compute it.

Application: Must support JSON file standard.

R\_Sec - 58 >> Spoofing (Priority: High)

Cause: DDS may be spoofed by an attacker and this may lead to information disclosure by Distribution center.

Requirement: DDS must/shall have authentication for data received.

Mechanism: A second way of authentication is asymmetric encryption.

Performance Requirement: Every information must be authenticated by DDS before DDS compute the information.

Application: Application must support HTTPS with SSL/TLS.

R\_Sec - 59 >> Repudiation (Priority: High)

Cause: DDS claims that it did not receive data (Request flight plans, Request a flight plan, Cancel a flight, Request status).

Requirement: DDS must/shall have digital signatures, and logging for data received.

Mechanism: The digital signature must be based on asymmetric encryption. The logging is Log4j 2.

Performance Requirement: Every information must be authenticated before DDS receive it. Every information must be stored in a log, including the valid and invalid and stored.

Application: Application must support digital signatures based on asymmetric encryption and Log4j 2.

R\_Sec - 60 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, and data filtering with rate limit, and replication for data received.

Mechanism: A second way of authentication is asymmetric encryption. Firewall IPTables to filter the input to accept only JSON files, and must limit the connections. The replication must use VM.

Performance Requirement: The authentication and filtering must occur in real-time. Each connection intent must take at least 1 second until 1 second to prevent DoS attacks.

Application: Application must support authentication based on asymmetric encryption and JSON file standard. The application is responsible for filter the JSON files.

R\_Sec - 61 >> Elevation of privilege (Priority: High)

Cause: DDS may be able to impersonate the context of DDS in order to gain additional privilege. An attacker may pass data into Distribution center in order to change the flow of program execution within DDS to the attacker's choosing. Distribution center may be able to remotely execute code for DDS.

Requirement: DDS must/shall have restrict inputs to a pattern, use role-based access, and have strong password for data received.

Mechanism: The inputs must be a validated JSON pattern. Employ the roles to restrict the access to server and data. Password must employ letters, numbers, and special characters.

Performance Requirement: The application is responsible to validate the user and on run time. The system must employ roles to access the server data.

Application: Application must support JSON file standard and use authentication method of user + password. Application must enforce the password.



R\_Sec - 62 >> Spoofing (Priority: High)

Cause: An attacker may fake that is an authorized Drone to send the wrong information, and this may lead to information disclosure by Drone.

Requirement: DDS must/shall have authenticated and secured channel for data received.

Mechanism: The channel must be secure and have asymmetric encryption as a second way of authentication.

Performance Requirement: The secure channel and authentication must not let the DDS system lazy.

Application: Application must support authentication is asymmetric encryption based and HTTPS protocols.

R\_Sec - 63 >> Elevation of privilege (Priority: High)

Cause: DDS may be able to impersonate the context of DDS in order to gain additional privilege. An attacker may pass data into Drone in order to change the flow of program execution within DDS to the attacker's choosing. Drone may be able to remotely execute code for DDS.

Requirement: DDS must/shall have restrict inputs for data received.

Mechanism: The input must be only JSON file.

Performance Requirement: Each input must be validated on run-time.

Application: Application must support JSON file standard.

R\_Sec - 64 >> Tampering (Priority: High)

Cause: Data flowing across Weather information may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Weather system -> DDS, or an information disclosure by Weather system -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Weather system -> DDS must/shall have tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol must not left the link between Weather system and DDS lazy.

Application: Application must support HTTPS with SSL/TLS.

R\_Sec - 65 >> Tampering (Priority: High)

Cause: Data flowing across Flight plan status, Flight cancelled, Flight intentions may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against USS -> DDS, or an information disclosure by USS -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link USS -> DDS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol must not left the link between USS and DDS lazy.

Application: Application must support HTTPS with SSL/TLS.

R\_Sec - 66 >> Information disclosure (Priority: High)

Cause: Data flowing across Flight plan status, Flight cancelled, Flight intentions may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link USS -> DDS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol must not left the link between USS and DDS lazy.

Application: Application must support HTTPS with SSL/TLS.

R\_Sec - 67 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered

with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Distribution center, or an information disclosure by DDS -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Distribution center must have data encryption or tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Application: The application must support HTTPS.

#### R\_Sec - 68 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Distribution center must have data encryption for data flow.

Mechanism: The data encryption is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Application: The application must support HTTPS.

#### R\_Sec - 69 >> Denial of service (Priority: High)

Cause: DDS -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> Distribution center must have appropriated authentication, and filtering with rate limit, and replication for data flow.

Mechanism: Distribution center must use assymetric encryption as a second way for authentication. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. The replication must use VM.

Performance Requirement: Distribution center must be able to accomplish the validation process of DDS feedback in less than 1 second.

Application: Application must support assymetric encryption, JSON files and replication.

#### R\_Sec - 70 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight plans, Request a flight plan, Cancel a flight, Request status may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Distribution center -> DDS must have data encryption, use privacy-enhanced protocols, and protect the secrets for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Application: The application must support HTTPS.

#### R\_Sec - 71 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Application: DDS application must support replication.

R\_Sec - 72 >> Tampering (Priority: High)

Cause: Data flowing across Request flight intentions, Request flight plan, Cancel flight plan may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> USS, or an information disclosure by DDS -> USS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> USS must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption must not delay the communication between DDS and USS.

Application: Application must support HTTPS.

R\_Sec - 73 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight intentions, Request flight plan, Cancel flight plan may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> USS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication.

Application: Application must support HTTPS.

R\_Sec - 74 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Drone -> DDS must have data encryption for data flow.

Mechanism: Use HTTPS as communication protocol.

Performance Requirement: The encryption must not overload or delay the DDS link to receive the drone feedback .

Application: DDS must support HTTPS protocol.

R\_Sec - 75 >> Denial of service (Priority: High)

Cause: Drone -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Drone -> DDS must have appropriated authentication, filtering, and replication for data flow.

Mechanism: The authentication shall be based on RSA. IPTables firewall to filter the input to accept only JSON files. The replication of DDS must use Virtual Machine.

Performance Requirement: The authentication must spent a time between 500 milliseconds until 1 second. The authentication and filtering must must be done in run-time.

Application: DDS application must support JSON file standard and run on a Virtual Machine.

R\_Sec - 76 >> Tampering (Priority: High)

Cause: Update drone system may be tampered with by an attacker. This may lead that an attakcer gain control the drone. All the Drone communication must be encrypted to prevent that someone unauthorized steals information or take control of the Drone. The link for communication must wor only in a short range.

Requirement: Link DDS -> Drone used to update the Drone must have data encryption for data flow.

Mechanism: AES 256.

Performance Requirement: The encryption must not delay the link or overload the Drone processor.

Application: Support AES 256.

## Interface I/O

### R\_Sec - 77 >> Tampering (Priority: High)

Cause: Update drone system may be tampered with by an attacker. This may lead that an attacker gain control the drone. All the Drone communication must be encrypted to prevent that someone unauthorized steals information or take control of the Drone. The link for communication must work only in a short range.

Requirement: Link DDS -> Drone used to update the Drone must have data encryption for data flow.

Mechanism: AES 256.

Performance Requirement: The encryption must not delay the link or overload the Drone processor.

Interface I/O: Bluetooth 5.0.

## Memory

### R\_Sec - 78 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, have filtering with rate limit, and replication for data received.

Mechanism: The authentication is SSL/TLS. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. DDS must have a replication of service.

Performance Requirement: The firewall must be work all the time, and each request must take 1 second until 1 second to be answered.

Memory: Each machine must have at least 8 GB of RAM memory.

### R\_Sec - 79 >> Denial of service (Priority: High)

Cause: DDS -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> Distribution center must have appropriated authentication, and filtering with rate limit, and replication for data flow.

Mechanism: Distribution center must use assymetric encryption as a second way for authentication. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. The replication must use VM.

Performance Requirement: Distribution center must be able to accomplish the validation process of DDS feedback in less than 1 second.

Memory: Each Virtual Machine of Distribution center must have 8 GB or more.

### R\_Sec - 80 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Memory: Each Virtual Machine of DDS must have 8 GB of RAM memory or higher.

#### R\_Sec - 81 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Drone, or an information disclosure by DDS -> Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Drone must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must use LoRaWAN with HTTPS or VPN connection.

Performance Requirement: The protocol must not delay the communication and process execution for critical operations.

Memory: Drone RAM memory is 1 GB.

### Operating system

#### R\_Sec - 82 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated rate limit for data received.

Mechanism: DDS must have firewall iptables to rate limit to incoming information.

Performance Requirement: The connection must spent a time between 1 second until 1 second.

Operating system: Use the operating system must support IPTables firewall.

#### R\_Sec - 83 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, have filtering with rate limit, and replication for data received.

Mechanism: The authentication is SSL/TLS. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. DDS must have a replication of service.

Performance Requirement: The firewall must be work all the time, and each request must take 1 second until 1 second to be answered.

Operating system: Use the operating system must support IPTables firewall. The operating system must support virtual machines.

#### R\_Sec - 84 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, and data filtering with rate limit, and replication for data received.

Mechanism: A second way of authentication is assymetric encryption. Firewall IPTables to filter the input to accept only JSON files, and must limit the connections. The replication must use VM.

Performance Requirement: The authentication and filtering must occur in real-time. Each connection intent must take at least 1 second until 1 second to prevent DoS attacks.

Operating system: The operating system must support IPTables firewall and run in a Virtual Machine.

#### R\_Sec - 85 >> Elevation of privilege (Priority: High)

Cause: DDS may be able to impersonate the context of DDS in order to gain additional privilege. An attacker may pass data into Distribution center in order to change the flow of program execution within DDS to the attacker's choosing. Distribution center may be able to remotely execute code for DDS.

Requirement: DDS must/shall have restrict inputs to a pattern, use role-based access, and

have strong password for data received.

Mechanism: The inputs must be a validated JSON pattern. Employ the roles to restrict the access to server and data. Password must employ letters, numbers, and special characters.

Performance Requirement: The application is responsible to validate the user and on run time. The system must employ roles to access the server data.

Operating system: System must implement the role-based access.

R\_Sec - 86 >> Denial of service (Priority: High)

Cause: DDS -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> Distribution center must have appropriated authentication, and filtering with rate limit, and replication for data flow.

Mechanism: Distribution center must use asymmetric encryption as a second way for authentication. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. The replication must use VM.

Performance Requirement: Distribution center must be able to accomplish the validation process of DDS feedback in less than 1 second.

Operating system: Must have a firewall to limit the communication to JSON files and limit the connection intentions.

R\_Sec - 87 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Operating system: Linux based with long-term support.

R\_Sec - 88 >> Tampering (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Drone -> DDS, or an information disclosure by Drone -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues. The attacker may also use it to make the DDS send the command to the Drone, and take advantage.

Requirement: Link Drone -> DDS must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must be HTTPS or MQTT.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission using strong encryption algorithm.

Operating system: DDS operating system must be designed for security.

R\_Sec - 89 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Drone -> DDS must have data encryption for data flow.

Mechanism: Use HTTPS as communication protocol.

Performance Requirement: The encryption must not overload or delay the DDS link to receive the drone feedback.

Operating system: Drone operating system must support HTTPS protocol.

R\_Sec - 90 >> Denial of service (Priority: High)

Cause: Drone -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Drone -> DDS must have appropriated authentication, filtering, and replication for data flow.

Mechanism: The authentication shall be based on RSA. IPTables firewall to filter the input to accept only JSON files. The replication of DDS must use Virtual Machine.

Performance Requirement: The authentication must spent a time between 500 milliseconds until 1 second. The authentication and filtering must must be done in run-time.

Operating system: DDS must use the operating system which supports IPTables firewall.

Drone operating system must sends only JSON files, which will be authenticated by DDS.

R\_Sec - 91 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Drone, or an information disclosure by DDS -> Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Drone must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must use LoRaWAN with HTTPS or VPN connection.

Performance Requirement: The protocol must not delay the communication and process execution for critical operations.

Operating system: Drone operating system is FlytOS which supports HTTPS.

R\_Sec - 92 >> Information disclosure (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Drone must have data encryption and privacy-enhanced protocols to protect the data flow.

Mechanism: The communication protocol must be HTTPS or use a VPN connection.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission.

Operating system: Drone operating system is FlytOS which supports HTTPS.

## Physical link

R\_Sec - 93 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated rate limit for data received.

Mechanism: DDS must have firewall iptables to rate limit to incoming information.

Performance Requirement: The connection must spent a time between 1 second until 1 second.

Physical link: The link must have at least 300 Mbps download and 300 Mbps upload of link speed.

R\_Sec - 94 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, have filtering with rate limit, and replication for data received.

Mechanism: The authentication is SSL/TLS. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. DDS must have a replication of service.

Performance Requirement: The firewall must be work all the time, and each request must take 1 second until 1 second to be answered.

Physical link: The link must have at least 300 Mbps download and 300 Mbps upload of speed.

#### R\_Sec - 95 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, and data filtering with rate limit, and replication for data received.

Mechanism: A second way of authentication is assymetric encryption. Firewall IPTables to filter the input to accept only JSON files, and must limit the connections. The replication must use VM.

Performance Requirement: The authentication and filtering must occur in real-time. Each connection intent must take at least 1 second until 1 second to prevent DoS attacks.

Physical link: The link must have at least 300 Mbps download and 300 Mbps upload of speed.

#### R\_Sec - 96 >> Spoofing (Priority: High)

Cause: An attacker may fake that is an authorized Drone to send the wrong information, and this may lead to information disclosure by Drone.

Requirement: DDS must/shall have authenticated and secured channel for data received.

Mechanism: The channel must be secure and have asymmetrich encryption as a second way of authentication.

Performance Requirement: The secure channel and authentication must not let the DDS system lazy.

Physical link: The link must have at least 300 Mbps download and 300 Mbps upload of speed.

#### R\_Sec - 97 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base to DDS may be sniffed by an attacker.

Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: DDS must only receives information from authorized Drones. Drones must use an encryption to accomplish the communication, and each drone must have their own key.

Mechanism: The authorization is public and private key for each drone.

Performance Requirement: Every trade of information must be encrypted using public and private key.

Physical link: The link must have at least 300 Mbps download and 300 Mbps upload of speed.

#### R\_Sec - 98 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, filtering and replication for data received.

Mechanism: The authentication is public and private key. The filtering must accept only JSON files. DDS must have several VMs to communicate with drones.

Performance Requirement: The authentication and filtering must be accomplished in run-time.

Physical link: The link must have at least 300 Mbps download and 300 Mbps upload of speed.

#### R\_Sec - 99 >> Tampering (Priority: High)

Cause: Data flowing across Weather information may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Weather system -> DDS, or an information disclosure by Weather system -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Weather system -> DDS must/shall have tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.



Performance Requirement: The communication protocol must not left the link between Wheather system and DDS lazy.

Physical link: The minimum link speed is 5 Mbps download and 5 Mbps upload of link speed.

R\_Sec - 100 >> Denial of service (Priority: High)

Cause: Weather system -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Weather system -> DDS must/shall have appropriated replication for data flow.

Mechanism: DDS must have an alternative link to receive the external information.

Performance Requirement: The alternative link must have the same capacity or higher.

Physical link: The alternative link must have Processor must have at least 300 Mbps download and 300 Mbps upload of link speed.

R\_Sec - 101 >> Tampering (Priority: High)

Cause: Data flowing across Flight plan status, Flight cancelled, Flight intentions may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against USS -> DDS, or an information disclosure by USS -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link USS -> DDS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol must not left the link between USS and DDS lazy.

Physical link: The minimum link speed is 5 Mbps download and 5 Mbps upload of link speed.

R\_Sec - 102 >> Information disclosure (Priority: High)

Cause: Data flowing across Flight plan status, Flight cancelled, Flight intentions may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link USS -> DDS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol must not left the link between USS and DDS lazy.

Physical link: The minimum link speed is 5 Mbps download and 5 Mbps upload of link speed.

R\_Sec - 103 >> Denial of service (Priority: High)

Cause: USS -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link USS -> DDS must/shall have appropriated replication for data flow.

Mechanism: DDS must have an alternative link to communicate with USS.

Performance Requirement: The alternative link between USS and DDS must have the same capacity or higher of the primary link.

Physical link: The link must have at least 300 Mbps download and 300 Mbps upload of link speed.

R\_Sec - 104 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Distribution center, or an information disclosure by DDS -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Distribution center must have data encryption or tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Physical link: The minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

R\_Sec - 105 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Distribution center must have data encryption for data flow.

Mechanism: The data encryption is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Physical link: The minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

R\_Sec - 106 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight plans, Request a flight plan, Cancel a flight, Request status may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Distribution center -> DDS must have data encryption, use privacy-enhanced protocols, and protect the secrets for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Physical link: The minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

R\_Sec - 107 >> Tampering (Priority: High)

Cause: Data flowing across Request flight intentions, Request flight plan, Cancel flight plan may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> USS, or an information disclosure by DDS -> USS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> USS must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption must not delay the communication between DDS and USS.

Physical link: The minimum link speed is 5 Mbps download and 5 Mbps upload of link speed.

R\_Sec - 108 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight intentions, Request flight plan, Cancel flight plan may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> USS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication.

Physical link: The minimum link speed is 5 Mbps download and 5 Mbps upload of link speed.

R\_Sec - 109 >> Denial of service (Priority: High)

Cause: DDS -> USS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> USS must/shall have a replication link for data flow.

Mechanism: USS must have an alternative link.

Performance Requirement: The alternative link must have the same capacity as the main or higher.

Physical link: The link must have at least 300 Mbps download and 300 Mbps upload of link speed.

#### R\_Sec - 110 >> Tampering (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Drone -> DDS, or an information disclosure by Drone -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues. The attacker may also use it to make the DDS send the command to the Drone, and take advantage.

Requirement: Link Drone -> DDS must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must be HTTPS or MQTT.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission using strong encryption algorithm.

Physical link: The minimum link speed is 5 Mbps download and 5 Mbps upload of speed.

#### R\_Sec - 111 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Drone -> DDS must have data encryption for data flow.

Mechanism: Use HTTPS as communication protocol.

Performance Requirement: The encryption must not overload or delay the DDS link to receive the drone feedback .

Physical link: The Drone minimum link speed is 5 Mbps download and 5 Mbps upload of link speed.

#### R\_Sec - 112 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Drone, or an information disclosure by DDS -> Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Drone must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must use LoRaWAN with HTTPS or VPN connection.

Performance Requirement: The protocol must not delay the communication and process execution for critical operations.

Physical link: Drone minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

#### R\_Sec - 113 >> Information disclosure (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Drone must have data encryption and privacy-enhanced protocols to protect the data flow.

Mechanism: The communication protocol must be HTTPS or use a VPN connection.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission.

Physical link: Drone minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

R\_Sec - 114 >> Tampering (Priority: High)

Cause: Update drone system may be tampered with by an attacker. This may lead that an attacker gain control the drone. All the Drone communication must be encrypted to prevent that someone unauthorized steals information or take control of the Drone. The link for communication must work only in a short range.

Requirement: Link DDS -> Drone used to update the Drone must have data encryption for data flow.

Mechanism: AES 256.

Performance Requirement: The encryption must not delay the link or overload the Drone processor.

Physical link: Support AES 256.

## Processor

R\_Sec - 115 >> Spoofing (Priority: High)

Cause: DDS may be spoofed by an attacker and this may lead to information disclosure by Weather system.

Requirement: DDS must/shall have authentication for data received.

Mechanism: The communication must employ SSL/TLS certificate.

Performance Requirement: DDS application must authenticate each connection in real-time.

Processor: Processor must have at least 1.8 Ghz.

R\_Sec - 116 >> Spoofing (Priority: High)

Cause: DDS may be spoofed by an attacker and this may lead to information disclosure by USS or make DDS believes that a flight plan is approved or not.

Requirement: DDS must/shall have authenticated and secured channel for data received.

Mechanism: The communication with SSL/TLS.

Performance Requirement: Each communication must be authenticated and sent in secure channel on real-time.

Processor: Processor must have at least 1.8 Ghz.

R\_Sec - 117 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, have filtering with rate limit, and replication for data received.

Mechanism: The authentication is SSL/TLS. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. DDS must have a replication of service.

Performance Requirement: The firewall must be work all the time, and each request must take 1 second until 1 second to be answered.

Processor: Processor must have at least 1.8 Ghz.

R\_Sec - 118 >> Spoofing (Priority: High)

Cause: DDS may be spoofed by an attacker and this may lead to information disclosure by Distribution center.

Requirement: DDS must/shall have authentication for data received.

Mechanism: A second way of authentication is asymmetric encryption.

Performance Requirement: Every information must be authenticated by DDS before DDS compute the information.

Processor: The processor must have at least 1.6 Ghz.

R\_Sec - 119 >> Repudiation (Priority: High)

Cause: DDS claims that it did not receive data (Request flight plans, Request a flight plan, Cancel a flight, Request status).

Requirement: DDS must/shall have digital signatures, and logging for data received.

Mechanism: The digital signature must be based on asymmetric encryption. The logging is Log4j 2.

Performance Requirement: Every information must be authenticated before DDS receive it. Every information must be stored in a log, including the valid and invalid and stored.

Processor: Processor must have at least 1.6 Ghz.

R\_Sec - 120 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, and data filtering with rate limit, and replication for data received.

Mechanism: A second way of authentication is asymmetric encryption. Firewall IPTables to filter the input to accept only JSON files, and must limit the connections. The replication must use VM.

Performance Requirement: The authentication and filtering must occur in real-time. Each connection intent must take at least 1 second until 1 second to prevent DoS attacks.

Processor: Processor must have at least 1.8 Ghz.

R\_Sec - 121 >> Spoofing (Priority: High)

Cause: An attacker may fake that is an authorized Drone to send the wrong information, and this may lead to information disclosure by Drone.

Requirement: DDS must/shall have authenticated and secured channel for data received.

Mechanism: The channel must be secure and have asymmetric encryption as a second way of authentication.

Performance Requirement: The secure channel and authentication must not let the DDS system lazy.

Processor: Processor must have at least 1.6 Ghz.

R\_Sec - 122 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base to DDS may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: DDS must only receives information from authorized Drones. Drones must use an encryption to accomplish the communication, and each drone must have their own key.

Mechanism: The authorization is public and private key for each drone.

Performance Requirement: Every trade of information must be encrypted using public and private key.

Processor: Processor must have at least 1.6 Ghz.

R\_Sec - 123 >> Denial of service (Priority: High)

Cause: DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: DDS must/shall have appropriated authentication, filtering and replication for data received.

Mechanism: The authentication is public and private key. The filtering must accept only JSON files. DDS must have several VMs to communicate with drones.

Performance Requirement: The authentication and filtering must be accomplished in run-time.

Processor: Processor must have at least 1.8 Ghz.

R\_Sec - 124 >> Tampering (Priority: High)

Cause: Data flowing across Weather information may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Weather

system -> DDS, or an information disclosure by Weather system -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Weather system -> DDS must/shall have tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol must not left the link between Weather system and DDS lazy.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 125 >> Tampering (Priority: High)

Cause: Data flowing across Flight plan status, Flight cancelled, Flight intentions may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against USS -> DDS, or an information disclosure by USS -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link USS -> DDS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol must not left the link between USS and DDS lazy.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 126 >> Information disclosure (Priority: High)

Cause: Data flowing across Flight plan status, Flight cancelled, Flight intentions may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link USS -> DDS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The communication protocol must not left the link between USS and DDS lazy.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 127 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Distribution center, or an information disclosure by DDS -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Distribution center must have data encryption or tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 128 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Distribution center must have data encryption for data flow.

Mechanism: The data encryption is HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 129 >> Denial of service (Priority: High)

Cause: DDS -> Distribution center crashes, halts, stops or runs slowly; in all cases violating

an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link DDS -> Distribution center must have appropriated authentication, and filtering with rate limit, and replication for data flow.

Mechanism: Distribution center must use assymetric encryption as a second way for authentication. Firewall IPTables to filter the input to accept only Json files, and limit the number of requisitions. The replication must use VM.

Performance Requirement: Distribution center must be able to accomplish the validation process of DDS feedback in less than 1 second.

Processor: Must have 1.8 GHz or higher.

#### R\_Sec - 130 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight plans, Request a flight plan, Cancel a flight, Request status may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Distribution center -> DDS must have data encryption, use privacy-enhanced protocols, and protect the secrets for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption for the link between DDS and Distribution center must not delay the communication.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 131 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must hava capacity to attend at least 300 requisitions per time.

Processor: Must have 1.8 GHz or higher.

#### R\_Sec - 132 >> Tampering (Priority: High)

Cause: Data flowing across Request flight intentions, Request flight plan, Cancel flight plan may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> USS, or an information disclosure by DDS -> USS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> USS must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must be HTTPS.

Performance Requirement: The encryption must not delay the communication between DDS and USS.

Processor: Processor must have at least 1.6 Ghz.

#### R\_Sec - 133 >> Information disclosure (Priority: High)

Cause: Data flowing across Request flight intentions, Request flight plan, Cancel flight plan may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> USS must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication.

Processor: Processor must have at least 1.6 Ghz.

R\_Sec - 134 >> Tampering (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Drone -> DDS, or an information disclosure by Drone -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues. The attacker may also use it to make the DDS send the command to the Drone, and take advantage.

Requirement: Link Drone -> DDS must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must be HTTPS or MQTT.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission using strong encryption algorithm.

Processor: Processor must have at least 1.2 GHz has four cores or more.

R\_Sec - 135 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Drone -> DDS must have data encryption for data flow.

Mechanism: Use HTTPS as communication protocol.

Performance Requirement: The encryption must not overload or delay the DDS link to receive the drone feedback .

Processor: Drone processor must have at least 1.2 Ghz and Quad core.

R\_Sec - 136 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Drone, or an information disclosure by DDS -> Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Drone must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must use LoRaWAN with HTTPS or VPN connection.

Performance Requirement: The protocol must not delay the communication and process execution for critical operations.

Processor: DDS processor must have at least 1.6 Ghz. Drone processor must have at least 1.2 GHz and four cores or more.

R\_Sec - 137 >> Information disclosure (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Drone must have data encryption and privacy-enhanced protocols to protect the data flow.

Mechanism: The communication protocol must be HTTPS or use a VPN connection.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission.

Processor: DDS processor must have at least 1.6 Ghz.

## Storage

R\_Sec - 138 >> Repudiation (Priority: High)

Cause: DDS claims that it did not receive data (Weather information).

Requirement: DDS must/shall have logging for data received.



Mechanism: The logging is Log4j 2.

Performance Requirement: The system must store all control actions and feedback must be fast and be stored.

Storage: The system must have 40 GB to log storage.

R\_Sec - 139 >> Repudiation (Priority: High)

Cause: DDS claims that it did not receive data (Flight plan status, Flight cancelled, Flight intentions).

Requirement: DDS must/shall have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The system must store all control actions and feedback must be fast and be stored.

Storage: The system must have 40 GB to log storage.

R\_Sec - 140 >> Repudiation (Priority: High)

Cause: DDS claims that it did not receive data (Request flight plans, Request a flight plan, Cancel a flight, Request status).

Requirement: DDS must/shall have digital signatures, and logging for data received.

Mechanism: The digital signature must be based on asymmetric encryption. The logging is Log4j 2.

Performance Requirement: Every information must be authenticated before DDS receive it. Every information must be stored in a log, including the valid and invalid and stored.

Storage: The system must have 40 GB to log storage.

R\_Sec - 141 >> Repudiation (Priority: High)

Cause: DDS claims that it did not receive data (Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base).

Requirement: DDS must log all the feedback received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The logging of all control actions and feedback must be securely stored. Sufficient reliable non-volatile storage SRNVS MB must be provided for one-week operation.

Storage: The DDS system must have 5 GB to log storage.

R\_Sec - 142 >> Denial of service (Priority: High)

Cause: Distribution center -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> DDS must have appropriated replication for data flow.

Mechanism: The DDS must have an alternative link to receive the control the data.

Performance Requirement: The DDS system must have capacity to attend at least 300 requisitions per time.

Storage: 750 GB or higher.

## **Virtual store**

### **Application**

R\_Sec - 143 >> Spoofing (Priority: High)

Cause: Virtual store may be spoofed by an attacker and this may lead to information disclosure by Customer.

Requirement: Virtual store must/shall have authentication with strong password and secure

channel for data received.

Mechanism: The authentication is user+password AND the secure channel is HTTPS.

Performance Requirement: The encryption must not delay the communication between Customer and Virtual store. It must be accomplished in less than 1 second.

Application: Support HTTPS.

R\_Sec - 144 >> Repudiation (Priority: High)

Cause: Virtual store claims that it did not receive data (Request the period for delivery).

Requirement: Virtual store must/shall have audit logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The system must store all control actions and feedback, it must delay processing of information.

Application: Must support Log4j 2.

R\_Sec - 145 >> Spoofing (Priority: High)

Cause: Virtual store may be spoofed by an attacker and this may lead to information disclosure by Distribution center.

Requirement: Virtual store must/shall have authenticated and secure channel for data received.

Mechanism: The communication protocol is HTTPS with SSL and TLS.

Performance Requirement: The encryption must not delay the communication between Distribution center and Virtual store. It must be accomplished in less than 1 second.

Application: Support HTTPS.

R\_Sec - 146 >> Repudiation (Priority: High)

Cause: Virtual store claims that it did not receive data (Request status, Delivery status, List of periods).

Requirement: Virtual store must/shall have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The system must store all control actions and feedback, it must delay processing of information.

Application: Must support Log4j 2.

R\_Sec - 147 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Customer -> Virtual store, or an information disclosure by Customer -> Virtual store. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Customer -> Virtual store must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The mechanism is HTTPS protocol for communication.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS.

R\_Sec - 148 >> Denial of service (Priority: High)

Cause: Customer -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Customer -> Virtual store must/shall have appropriated authentication, have rate limit with filtering, and have replication for data flow.

Mechanism: The authentication is user+password. Virtual store must limit the connections from Customer with a firewall. The filtering must accept only valid JSON files. The replication must use VM.

Performance Requirement: Virtual store system must be able to accomplish the authentication process in less than 1 second.

Application: Must have a validation for user and password, accept only JSON files and

support replication.

R\_Sec - 149 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Customer, or an information disclosure by Virtual store -> Customer. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Customer must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS.

R\_Sec - 150 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Customer must/shall data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS.

R\_Sec - 151 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Customer -> Virtual store must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Application: The application must support HTTPS.

R\_Sec - 152 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Distribution center, or an information disclosure by Virtual store -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Distribution center must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Application: The application must support HTTPS and have an authentication method based on user + password.

R\_Sec - 153 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker.

Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Distribution center must have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Application: The application must support HTTPS.

R\_Sec - 154 >> Denial of service (Priority: High)

Cause: Virtual store -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Virtual store -> Distribution center shall have appropriated authentication, have a filtering with rate limit, and replication for data flow.

Mechanism: The Distribution center must have alternative links and use VM. The authentications is assymetric. The Distribution center filter must accept only valid JSON files. The rate limit must limit the connections trough firewall.

Performance Requirement: The validation process of Distribution center must take less than 1 second.

Application: Must support multiple instances and JSON files standard.

R\_Sec - 155 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Distribution center -> Virtual store, or an information disclosure by Distribution center -> Virtual store. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Distribution center -> Virtual store must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The encryption for Distribution center must not delay the communication Delivery center system and Virtual store.

Application: The application must support HTTPS with SSL/TLS.

R\_Sec - 156 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Distribution center -> Virtual store must have data encryption for data flow.

Mechanism: The communication protocol is HTTPS with SSL/TLS.

Performance Requirement: The encryption for Distribution center must not delay the communication Delivery center system and Virtual store.

Application: The application must support HTTPS with SSL/TLS.

R\_Sec - 157 >> Denial of service (Priority: High)

Cause: Distribution center -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> Virtual store must have appropriated replication, authentication, and filtering with rate limit for data flow.

Mechanism: The Virtual store must have alternative links. The authentications is assymetric. The Virtual store filter must accept only valid JSON files. The rate limit must limit the connections trough firewall. The replication must use VM.

Performance Requirement: The Virtual store must be able to accomplish the validation process of the Distribution center in less than 1 second.

Application: Application must support HTTPS, JSON files and replication.

## Interface I/O

## Memory

R\_Sec - 158 >> Denial of service (Priority: High)

Cause: Distribution center -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> Virtual store must have appropriated replication, authentication, and filtering with rate limit for data flow.

Mechanism: The Virtual store must have alternative links. The authentications is assymetric. The Virtual store filter must accept only valid JSON files. The rate limit must limit the connections trough firewall. The replication must use VM.

Performance Requirement: The Virtual store must be able to accomplish the validation process of the Distribution center in less than 1 second.

Memory: Virtual store must have 8 GB or more.

## Operating system

R\_Sec - 159 >> Denial of service (Priority: High)

Cause: Customer -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Customer -> Virtual store must/shall have appropriated authentication, have rate limit with filtering, and have replication for data flow.

Mechanism: The authentication is user+password. Virtual store must limit the connections from Customer with a firewall. The filtering must accept only valid JSON files. The replication must use VM.

Performance Requirement: Virtual store system must be able to accomplish the authentication process in less than 1 second.

Operating system: Virtual store operating system must have have replication of the application and have a firewall.

R\_Sec - 160 >> Denial of service (Priority: High)

Cause: Virtual store -> Distribution center crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Virtual store -> Distribution center shall have appropriated authentication, have a filtering with rate limit, and replication for data flow.

Mechanism: The Distribution center must have alternative links and use VM. The authentications is assymetric. The Distribution center filter must accept only valid JSON files. The rate limit must limit the connections trough firewall.

Performance Requirement: The validation process of Distribution center must take less than 1 second.

Operating system: The operating system is Linux based operating system and must support the use of Virtual Machines and have a firewall.

R\_Sec - 161 >> Denial of service (Priority: High)

Cause: Distribution center -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> Virtual store must have appropriated replication, authentication, and filtering with rate limit for data flow.  
Mechanism: The Virtual store must have alternative links. The authentications is assymetric. The Virtual store filter must accept only valid JSON files. The rate limit must limit the connections trough firewall. The replication must use VM.  
Performance Requirement: The Virtual store must be able to accomplish the validation process of the Distribution center in less than 1 second.  
Operating system: Must have a firewall to limit the communication to JSON files and limit the connection intentions.

## Physical link

### R\_Sec - 162 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Distribution center, or an information disclosure by Virtual store -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Distribution center must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Physical link: Must have 10 Mbps upload and 10 Mbps download of speed or higher.

### R\_Sec - 163 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Distribution center must have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Physical link: Must have 10 Mbps upload and 10 Mbps download of speed or higher.

## Processor

### R\_Sec - 164 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Customer -> Virtual store, or an information disclosure by Customer -> Virtual store. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Customer -> Virtual store must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The mechanism is HTTPS protocol for communication.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

R\_Sec - 165 >> Denial of service (Priority: High)

Cause: Customer -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Customer -> Virtual store must/shall have appropriated authentication, have rate limit with filtering, and have replication for data flow.

Mechanism: The authentication is user+password. Virtual store must limit the connections from Customer with a firewall. The filtering must accept only valid JSON files. The replication must use VM.

Performance Requirement: Virtual store system must be able to accomplish the authentication process in less than 1 second.

Processor: Processor must have 1.6 Ghz or higher.

R\_Sec - 166 >> Tampering (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Customer, or an information disclosure by Virtual store -> Customer. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Customer must/shall have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

R\_Sec - 167 >> Information disclosure (Priority: High)

Cause: Data flowing across Request status, Delivery status, List of periods may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Customer must/shall data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

R\_Sec - 168 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Customer -> Virtual store must/shall have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The encryption must not delay the communication between Virtual store and Customer. It must be accomplished in less than 1 second.

Processor: Processor must have 1.4 Ghz or higher.

R\_Sec - 169 >> Tampering (Priority: High)

Cause: Data flowing across Request the period for delivery may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Virtual store -> Distribution center, or an information disclosure by Virtual store -> Distribution center. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link Virtual store -> Distribution center must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be

encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Processor: Processor must have 1.4 Ghz or higher.

R\_Sec - 170 >> Information disclosure (Priority: High)

Cause: Data flowing across Request the period for delivery may be sniffed by an attacker.

Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Virtual store -> Distribution center must have data encryption for data flow.

Mechanism: The communication protocol is HTTPS.

Performance Requirement: The Virtual store communication to the Distribution center must be encrypted. The encryption must not delay the communication of Distribution center with DDS and Virtual store.

Processor: Processor must have 1.4 Ghz or higher.

R\_Sec - 171 >> Denial of service (Priority: High)

Cause: Distribution center -> Virtual store crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Distribution center -> Virtual store must have appropriated replication, authentication, and filtering with rate limit for data flow.

Mechanism: The Virtual store must have alternative links. The authentications is assymetric. The Virtual store filter must accept only valid JSON files. The rate limit must limit the connections through firewall. The replication must use VM.

Performance Requirement: The Virtual store must be able to accomplish the validation process of the Distribution center in less than 1 second.

Processor: Must have 1.8 Ghz or higher.

## Storage

R\_Sec - 172 >> Repudiation (Priority: High)

Cause: Virtual store claims that it did not receive data (Request the period for delivery).

Requirement: Virtual store must/shall have audit logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The system must store all control actions and feedback, it must delay processing of information.

Storage: The system must have 40 GB to log storage.

R\_Sec - 173 >> Repudiation (Priority: High)

Cause: Virtual store claims that it did not receive data (Request status, Delivery status, List of periods).

Requirement: Virtual store must/shall have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: The system must store all control actions and feedback, it must delay processing of information.

Storage: The system must have 40 GB to log storage.

## Drone

## Application



R\_Sec - 174 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Drone -> DDS must have data encryption for data flow.

Mechanism: Use HTTPS as communication protocol.

Performance Requirement: The encryption must not overload or delay the DDS link to receive the drone feedback .

Application: DDS must support HTTPS protocol.

R\_Sec - 175 >> Denial of service (Priority: High)

Cause: Drone -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Drone -> DDS must have appropriated authentication, filtering, and replication for data flow.

Mechanism: The authentication shall be based on RSA. IPTables firewall to filter the input to accept only JSON files. The replication of DDS must use Virtual Machine.

Performance Requirement: The authentication must spent a time between 500 milliseconds until 1 second. The authentication and filtering must must be done in run-time.

Application: DDS application must support JSON file standard and run on a Virtual Machine.

R\_Sec - 176 >> Tampering (Priority: High)

Cause: Update drone system may be tampered with by an attacker. This may lead that an attacker gain control the drone. All the Drone communication must be encrypted to prevent that someone unauthorized steals information or take control of the Drone. The link for communication must wor only in a short range.

Requirement: Link DDS -> Drone used to update the Drone must have data encryption for data flow.

Mechanism: AES 256.

Performance Requirement: The encryption must not delay the link or overload the Drone processor.

Application: Support AES 256.

## Interface I/O

R\_Sec - 177 >> Spoofing (Priority: High)

Cause: An attacker may break the Drone password and takes control of the Drone to steal the Drone or package. Drone may be spoofed by an attacker and this may lead to information disclosure by DDS.

Requirement: Drone must/shall have authentication and secure channel for data received.

Mechanism: The authentication is user and strong password (with letters, numbers and special characters). The secure channel is HTTPS or VPN.

Performance Requirement: The encryption must use HTTPS protocol to not delay the communication. The process of authentication must be user and password.

Interface I/O: Cellphone network connection.

R\_Sec - 178 >> Spoofing (Priority: High)

Cause: An attacker may break the Drone password and takes control of the Drone to steal the Drone or package. Drone may be spoofed by an attacker and this may lead to information disclosure by DDS.

Requirement: Only the DDS must have access to connect and control the Drone. Drone must use the updated firmware provided by manufacturer.

Mechanism: Firmware updates.

Performance Requirement: The system firmware must be updated every month by an

operator.

Interface I/O: USB connection.

R\_Sec - 179 >> Denial of service (Priority: High)

Cause: Drone crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Drone must/shall have appropriated authentication and accept only files in a standardized pattern for data received.

Mechanism: The authentication shall use user + password and IP address. The drone filter must accept only validated JSON file.

Performance Requirement: The operating system must authenticate and filter the intent of connections in real-time. Drone must accept just one connection per time.

Interface I/O: Cellphone network connection.

R\_Sec - 180 >> Spoofing (Priority: High)

Cause: A way to take control of a Drone. Attackers feed drones with false GPS coordinates and take full control of the platform. The Drone thinks it is following its original flight pattern but in fact is being led to a different location. Drone may be spoofed by an attacker and this may lead to information disclosure by GPS positioning.

Requirement: The drone must use the combined positioning system using the GPS together with cell phone network.

Mechanism: The drone must use A-GPS (Assisted GPS).

Performance Requirement: The system must always use the A-GPS to keep the precision under 10 meters.

Interface I/O: 4G LTE Cellphone network connection and GPS connection.

R\_Sec - 181 >> Spoofing (Priority: High)

Cause: A way to take control of a Drone. Attackers feed drones with false Cellular network and take full control of the platform. The Drone thinks it is following its original flight pattern but in fact is being led to a different location. Drone may be spoofed by an attacker and this may lead to information disclosure by Cellular network positioning.

Requirement: The drone must use the combined positioning with GPS.

Mechanism: The drone must use A-GPS (Assisted GPS), a combined positioning, considering the GPS positioning and the Cell phone network to have more accurate GPS positioning.

Performance Requirement: The combined GPS must be compatible with different technologies, such as GLONASS, BeiDou and Galileo.

Interface I/O: Cellphone network connection and GPS connection supporting A-GPS connection.

R\_Sec - 182 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack against Drone or an elevation of privilege attack against Drone or an information disclosure by Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Drone shall have data encryption for data received.

Mechanism: Use a VPN service to accomplish the communication.

Performance Requirement: The VPN must increase the communication time in less than 500ms.

Interface I/O: Cellphone network connection.

R\_Sec - 183 >> Denial of service (Priority: High)

Cause: GPS positioning -> Drone crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Drone must connect with at least 10 GPS satellites, and be compatible with glonass technology.

Mechanism: Operating system must support connection with multiple satellites.

Performance Requirement: Drone must take less than 30 seconds to identify the minimum number of satellites.

Interface I/O: GPS connection (compatible with GLONASS).

#### R\_Sec - 184 >> Tampering (Priority: High)

Cause: Update drone system may be tampered with by an attacker. This may lead that an attacker gain control the drone. All the Drone communication must be encrypted to prevent that someone unauthorized steals information or take control of the Drone. The link for communication must work only in a short range.

Requirement: Link DDS -> Drone used to update the Drone must have data encryption for data flow.

Mechanism: AES 256.

Performance Requirement: The encryption must not delay the link or overload the Drone processor.

Interface I/O: Bluetooth 5.0.

## Memory

#### R\_Sec - 185 >> Elevation of privilege (Priority: High)

Cause: Drone may be able to impersonate the context of Drone in order to gain additional privilege. An attacker may pass data into DDS in order to change the flow of program execution within Drone to the attacker's choosing. DDS may be able to remotely execute code for Drone.

Requirement: Drone must have role-based access and strong password for data received.

Mechanism: Use the role permissions. Strong password must include letters, numbers, and special characters.

Performance Requirement: The authentication must take less than 1 second.

Memory: 1 GB RAM

#### R\_Sec - 186 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack against Drone or an elevation of privilege attack against Drone or an information disclosure by Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Drone shall have data encryption for data received.

Mechanism: Use a VPN service to accomplish the communication.

Performance Requirement: The VPN must increase the communication time in less than 500ms.

Memory: 1 GB of RAM memory.

#### R\_Sec - 187 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Drone, or an information disclosure by DDS -> Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Drone must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must use LoRaWAN with HTTPS or VPN connection.

Performance Requirement: The protocol must not delay the communication and process execution for critical operations.

Memory: Drone RAM memory is 1 GB.

## Operating system

### R\_Sec - 188 >> Spoofing (Priority: High)

Cause: An attacker may break the Drone password and takes control of the Drone to steal the Drone or package. Drone may be spoofed by an attacker and this may lead to information disclosure by DDS.

Requirement: Drone must/shall have authentication and secure channel for data received.

Mechanism: The authentication is user and strong password (with letters, numbers and special characters). The secure channel is HTTPS or VPN.

Performance Requirement: The encryption must use HTTPS protocol to not delay the communication. The process of authentication must be user and password.

Operating system: Operating system must support HTTPS. The authentication must require a user and strong password, and must be accomplished in less than 1 second.

### R\_Sec - 189 >> Spoofing (Priority: High)

Cause: An attacker may break the Drone password and takes control of the Drone to steal the Drone or package. Drone may be spoofed by an attacker and this may lead to information disclosure by DDS.

Requirement: Only the DDS must have access to connect and control the Drone. Drone must use the updated firmware provided by manufacturer.

Mechanism: Firmware updates.

Performance Requirement: The system firmware must be updated every month by an operator.

Operating system: Support updates.

### R\_Sec - 190 >> Repudiation (Priority: High)

Cause: Drone claims that it did not receive data (Start flight, Back to home, Go to position).

Requirement: Drone must have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: Drone must log all data received and sent.

Operating system: Support Log4j 2.

### R\_Sec - 191 >> Information disclosure (Priority: High)

Cause: An attacker gain control of the Drone and steals the information stored about the client. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: All data received and stored by Drone must have encryption.

Mechanism: SQLite Encryption Extension (SEE).

Performance Requirement: The encryption must affect the drone performance in less than 300 ms.

Operating system: Support SQLite Encryption Extension (SEE).

### R\_Sec - 192 >> Denial of service (Priority: High)

Cause: Drone crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Drone must/shall have appropriated authentication and accept only files in a standardized pattern for data received.

Mechanism: The authentication shall use user + password and IP address. The drone filter must accept only validated JSON file.

Performance Requirement: The operating system must authenticate and filter the intent of connections in real-time. Drone must accept just one connection per time.

Operating system: The operating system must be FlytOS with support to authentication.

### R\_Sec - 193 >> Elevation of privilege (Priority: High)

Cause: Drone may be able to impersonate the context of Drone in order to gain additional

privilege. An attacker may pass data into DDS in order to change the flow of program execution within Drone to the attacker's choosing. DDS may be able to remotely execute code for Drone.

Requirement: Drone must have role-based access and strong password for data received.

Mechanism: Use the role permissions. Strong password must include letters, numbers, and special characters.

Performance Requirement: The authentication must take less than 1 second.

Operating system: The operating system must be FlytOS with support authentication and is a system designed for security.

#### R\_Sec - 194 >> Spoofing (Priority: High)

Cause: Drone may be spoofed by an attacker to hijack the Drone.

Requirement: Drone must have accept one connection per time.

Mechanism: The operating system with limit to one connection per time.

Performance Requirement: The operating system must accept only 1 connection per time.

Operating system: The operating system must be FlytOS with support authentication and is a system designed for security.

#### R\_Sec - 195 >> Tampering (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Drone -> DDS, or an information disclosure by Drone -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues. The attacker may also use it to make the DDS send the command to the Drone, and take advantage.

Requirement: Link Drone -> DDS must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must be HTTPS or MQTT.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission using strong encryption algorithm.

Operating system: DDS operating system must be designed for security.

#### R\_Sec - 196 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Drone -> DDS must have data encryption for data flow.

Mechanism: Use HTTPS as communication protocol.

Performance Requirement: The encryption must not overload or delay the DDS link to receive the drone feedback.

Operating system: Drone operating system must support HTTPS protocol.

#### R\_Sec - 197 >> Denial of service (Priority: High)

Cause: Drone -> DDS crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Link Drone -> DDS must have appropriated authentication, filtering, and replication for data flow.

Mechanism: The authentication shall be based on RSA. IPTables firewall to filter the input to accept only JSON files. The replication of DDS must use Virtual Machine.

Performance Requirement: The authentication must spent a time between 500 milliseconds until 1 second. The authentication and filtering must be done in run-time.

Operating system: DDS must use the operating system which supports IPTables firewall.

Drone operating system must send only JSON files, which will be authenticated by DDS.

#### R\_Sec - 198 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with

by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Drone, or an information disclosure by DDS -> Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Drone must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must use LoRaWAN with HTTPS or VPN connection.

Performance Requirement: The protocol must not delay the communication and process execution for critical operations.

Operating system: Drone operating system is FlytOS which supports HTTPS.

R\_Sec - 199 >> Information disclosure (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Drone must have data encryption and privacy-enhanced protocols to protect the data flow.

Mechanism: The communication protocol must be HTTPS or use a VPN connection.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission.

Operating system: Drone operating system is FlytOS which supports HTTPS.

R\_Sec - 200 >> Denial of service (Priority: High)

Cause: GPS positioning -> Drone crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Drone must connect with at least 10 GPS satellites, and be compatible with glonass technology.

Mechanism: Operating system must support connection with multiple satellites.

Performance Requirement: Drone must take less than 30 seconds to identify the minimum number of satellites.

Operating system: Drone operating system is FlytOS.

## Physical link

R\_Sec - 201 >> Spoofing (Priority: High)

Cause: An attacker may break the Drone password and takes control of the Drone to steal the Drone or package. Drone may be spoofed by an attacker and this may lead to information disclosure by DDS.

Requirement: Drone must/shall have authentication and secure channel for data received.

Mechanism: The authentication is user and strong password (with letters, numbers and special characters). The secure channel is HTTPS or VPN.

Performance Requirement: The encryption must use HTTPS protocol to not delay the communication. The process of authentication must be user and password.

Physical link: DDS link must have at least 5 Mbps download and 5 Mbps upload. The Drone must use 4G or LTE connection.

R\_Sec - 202 >> Spoofing (Priority: High)

Cause: A way to take control of a Drone. Attackers feed drones with false GPS coordinates and take full control of the platform. The Drone thinks it is following its original flight pattern but in fact is being led to a different location. Drone may be spoofed by an attacker and this may lead to information disclosure by GPS positioning.

Requirement: The drone must use the combined positioning system using the GPS together with cell phone network.

Mechanism: The drone must use A-GPS (Assisted GPS).

Performance Requirement: The system must always use the A-GPS to keep the precision under 10 meters.

Physical link: 4G LTE for cellphone connection and Glonass for GPS.

#### R\_Sec - 203 >> Spoofing (Priority: High)

Cause: A way to take control of a Drone. Attackers feed drones with false Cellular network and take full control of the platform. The Drone thinks it is following its original flight pattern but in fact is being led to a different location. Drone may be spoofed by an attacker and this may lead to information disclosure by Cellular network positioning.

Requirement: The drone must use the combined positioning with GPS.

Mechanism: The drone must use A-GPS (Assisted GPS), a combined positioning, considering the GPS positioning and the Cell phone network to have more accurate GPS positioning.

Performance Requirement: The combined GPS must be compatible with different technologies, such as GLONASS, BeiDou and Galileo.

Physical link: 4G or LTE for cellphone connection and Glonass for GPS.

#### R\_Sec - 204 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack against Drone or an elevation of privilege attack against Drone or an information disclosure by Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Drone shall have data encryption for data received.

Mechanism: Use a VPN service to accomplish the communication.

Performance Requirement: The VPN must increase the communication time in less than 500ms.

Physical link: 4G or LTE.

#### R\_Sec - 205 >> Tampering (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Drone -> DDS, or an information disclosure by Drone -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues. The attacker may also use it to make the DDS send the command to the Drone, and take advantage.

Requirement: Link Drone -> DDS must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must be HTTPS or MQTT.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission using strong encryption algorithm.

Physical link: The minimum link speed is 5 Mbps download and 5 Mbps upload of speed.

#### R\_Sec - 206 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Drone -> DDS must have data encryption for data flow.

Mechanism: Use HTTPS as communication protocol.

Performance Requirement: The encryption must not overload or delay the DDS link to receive the drone feedback.

Physical link: The Drone minimum link speed is 5 Mbps download and 5 Mbps upload of link speed.

#### R\_Sec - 207 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack

against DDS -> Drone, or an information disclosure by DDS -> Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Drone must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must use LoRaWAN with HTTPS or VPN connection.

Performance Requirement: The protocol must not delay the communication and process execution for critical operations.

Physical link: Drone minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

#### R\_Sec - 208 >> Information disclosure (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Drone must have data encryption and privacy-enhanced protocols to protect the data flow.

Mechanism: The communication protocol must be HTTPS or use a VPN connection.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission.

Physical link: Drone minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

#### R\_Sec - 209 >> Denial of service (Priority: High)

Cause: GPS positioning -> Drone crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Drone must connect with at least 10 GPS satellites, and be compatible with glonass technology.

Mechanism: Operating system must support connection with multiple satellites.

Performance Requirement: Drone must take less than 30 seconds to identify the minimum number of satellites.

Physical link: Glonass network.

#### R\_Sec - 210 >> Tampering (Priority: High)

Cause: Update drone system may be tampered with by an attacker. This may lead that an attacker gain control the drone. All the Drone communication must be encrypted to prevent that someone unauthorized steals information or take control of the Drone. The link for communication must work only in a short range.

Requirement: Link DDS -> Drone used to update the Drone must have data encryption for data flow.

Mechanism: AES 256.

Performance Requirement: The encryption must not delay the link or overload the Drone processor.

Physical link: Support AES 256.

### Processor

#### R\_Sec - 211 >> Information disclosure (Priority: High)

Cause: An attacker gain control of the Drone and steals the information stored about the client. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: All data received and stored by Drone must have encryption.

Mechanism: SQLite Encryption Extension (SEE).

Performance Requirement: The encryption must affect the drone performance in less than



300 ms.

Processor: Quad Core 1.2 GHz.

R\_Sec - 212 >> Elevation of privilege (Priority: High)

Cause: Drone may be able to impersonate the context of Drone in order to gain additional privilege. An attacker may pass data into DDS in order to change the flow of program execution within Drone to the attacker's choosing. DDS may be able to remotely execute code for Drone.

Requirement: Drone must have role-based access and strong password for data received.

Mechanism: Use the role permissions. Strong password must include letters, numbers, and special characters.

Performance Requirement: The authentication must take less than 1 second.

Processor: Quad Core 1.2 GHz 64bit CPU.

R\_Sec - 213 >> Spoofing (Priority: High)

Cause: A way to take control of a Drone. Attackers feed drones with false GPS coordinates and take full control of the platform. The Drone thinks it is following its original flight pattern but in fact is being led to a different location. Drone may be spoofed by an attacker and this may lead to information disclosure by GPS positioning.

Requirement: The drone must use the combined positioning system using the GPS together with cell phone network.

Mechanism: The drone must use A-GPS (Assisted GPS).

Performance Requirement: The system must always use the A-GPS to keep the precision under 10 meters.

Processor: Quad core with 1.2 GHz or higher.

R\_Sec - 214 >> Spoofing (Priority: High)

Cause: A way to take control of a Drone. Attackers feed drones with false Cellular network and take full control of the platform. The Drone thinks it is following its original flight pattern but in fact is being led to a different location. Drone may be spoofed by an attacker and this may lead to information disclosure by Cellular network positioning.

Requirement: The drone must use the combined positioning with GPS.

Mechanism: The drone must use A-GPS (Assisted GPS), a combined positioning, considering the GPS positioning and the Cell phone network to have more accurate GPS positioning.

Performance Requirement: The combined GPS must be compatible with different technologies, such as GLONASS, BeiDou and Galileo.

Processor: Quad core with 1.2 GHz or higher.

R\_Sec - 215 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack against Drone or an elevation of privilege attack against Drone or an information disclosure by Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Drone shall have data encryption for data received.

Mechanism: Use a VPN service to accomplish the communication.

Performance Requirement: The VPN must increase the communication time in less than 500ms.

Processor: Quad core with 1.4 GHz or higher.

R\_Sec - 216 >> Tampering (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against Drone -> DDS, or an information disclosure by Drone -> DDS. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues. The attacker may also use it to make the DDS send the command to the Drone, and take advantage.

Requirement: Link Drone -> DDS must have data encryption and tamper-resistant protocols

for data flow.

Mechanism: The communication protocol must be HTTPS or MQTT.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission using strong encryption algorithm.

Processor: Processor must have at least 1.2 GHz has four cores or more.

R\_Sec - 217 >> Information disclosure (Priority: High)

Cause: Data flowing across Drone battery, Drone position, Emergency situation, Drone delivery status, Delivery status, Returning to base may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link Drone -> DDS must have data encryption for data flow.

Mechanism: Use HTTPS as communication protocol.

Performance Requirement: The encryption must not overload or delay the DDS link to receive the drone feedback .

Processor: Drone processor must have at least 1.2 Ghz and Quad core.

R\_Sec - 218 >> Tampering (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be tampered with by an attacker. This may lead to a denial of service attack or an elevation of privilege attack against DDS -> Drone, or an information disclosure by DDS -> Drone. Failure to verify that input is as expected is a root cause of a very large number of exploitable issues.

Requirement: Link DDS -> Drone must have data encryption and tamper-resistant protocols for data flow.

Mechanism: The communication protocol must use LoRaWAN with HTTPS or VPN connection.

Performance Requirement: The protocol must not delay the communication and process execution for critical operations.

Processor: DDS processor must have at least 1.6 Ghz. Drone processor must have at least 1.2 GHz and four cores or more.

R\_Sec - 219 >> Information disclosure (Priority: High)

Cause: Data flowing across Start flight, Back to home, Go to position may be sniffed by an attacker. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: Link DDS -> Drone must have data encryption and privacy-enhanced protocols to protect the data flow.

Mechanism: The communication protocol must be HTTPS or use a VPN connection.

Performance Requirement: The protocol must not delay the communication and allow secure data transmission.

Processor: DDS processor must have at least 1.6 Ghz.

R\_Sec - 220 >> Denial of service (Priority: High)

Cause: GPS positioning -> Drone crashes, halts, stops or runs slowly; in all cases violating an availability metric. An external agent interrupts data flowing across a trust boundary in either direction.

Requirement: Drone must connect with at least 10 GPS satellites, and be compatible with glonass technology.

Mechanism: Operating system must support connection with multiple satellites.

Performance Requirement: Drone must take less than 30 seconds to identify the minimum number of satellites.

Processor: Drone must have Quad Core 1.2 GHz.

Storage

R\_Sec - 221 >> Repudiation (Priority: High)

Cause: Drone claims that it did not receive data (Start flight, Back to home, Go to position).

Requirement: Drone must have logging for data received.

Mechanism: The logging is Log4j 2.

Performance Requirement: Drone must log all data received and sent.

Storage: The system must have 4 GB to log storage.

R\_Sec - 222 >> Information disclosure (Priority: High)

Cause: An attacker gain control of the Drone and steals the information stored about the client. Depending on what type of data an attacker can read, it may be used to attack other parts of the system or simply be a disclosure of information leading to compliance violations.

Requirement: All data received and stored by Drone must have encryption.

Mechanism: SQLite Encryption Extension (SEE).

Performance Requirement: The encryption must affect the drone performance in less than 300 ms.

Storage: 2 GB of storage for database.

## **Business**

### **Distribution center**

#### Application

R\_Bus - 1 >> Distribution center

Requirement: Distribution center have replication to attend the demands of Virtual store.

Performance Requirement: Distribution center must have replication for the application using scalable VM.

Application: The Distribution center application must support multiple instances and windows based systems.

R\_Bus - 2 >> Distribution center

Requirement: Distribution center must have an authentication to communicate with the Virtual store and DDS.

Performance Requirement: The authentication method for Virtual store and DDS are distinct and take less than 10 seconds to accomplish the authentication.

Application: Distribution center must require user and password.

#### Interface I/O

#### Memory

R\_Bus - 3 >> Distribution center

Requirement: Distribution center must have an authentication to communicate with the Virtual store and DDS.

Performance Requirement: The authentication method for Virtual store and DDS are distinct and take less than 10 seconds to accomplish the authentication.

Memory: 8 GB of RAM memory.

#### R\_Bus - 4 >> Distribution center

Requirement: Distribution center use encrypted connection to communicate with Virtual store and DDS.

Performance Requirement: The encryption must not delay the communication of Distribution center with Virtual store and DDS. It must be accomplished in less than 4 seconds.

Memory: 8 GB of RAM memory.

#### R\_Bus - 5 >> Distribution center

Requirement: Distribution center is responsible to suggest the time for delivery, that will be chosen by a Customer. The suggestions are based on the list of free days to perform the delivery.

Performance Requirement: The Distribution center must be able to provide a list with suggestions in less than 2 seconds.

Memory: 8 GB of RAM memory.

### Operating system

#### R\_Bus - 6 >> Distribution center

Requirement: Distribution center have replication to attend the demands of Virtual store.

Performance Requirement: Distribution center must have replication for the application using scalable VM.

Operating system: Distribution center must have a Windows based operating system that supports Virtual Machine.

### Physical link

#### R\_Bus - 7 >> Distribution center

Requirement: Distribution center have more than 1 link for internet connection.

Performance Requirement: Each link must have enough speed to deal with the data sent/receive between Virtual store and DDS.

Physical link: The alternative link must have 300 MB download and 300 MB upload.

#### R\_Bus - 8 >> Distribution center

Requirement: Distribution center use encrypted connection to communicate with Virtual store and DDS.

Performance Requirement: The encryption must not delay the communication of Distribution center with Virtual store and DDS. It must be accomplished in less than 4 seconds.

Physical link: The alternative link must have 300 MB download and 300 MB upload.

#### R\_Bus - 9 >> Distribution center

Requirement: Distribution center is responsible to suggest the time for delivery, that will be chosen by a Customer. The suggestions are based on the list of free days to perform the delivery.

Performance Requirement: The Distribution center must be able to provide a list with suggestions in less than 2 seconds.

Physical link: The connection link must have 300 MB download and 300 MB upload.

### Processor

#### R\_Bus - 10 >> Distribution center

Requirement: Distribution center must have an authentication to communicate with the Virtual

store and DDS.

Performance Requirement: The authentication method for Virtual store and DDS are distinct and take less than 10 seconds to accomplish the authentication.

Processor: Processor must have at least 1.8 Ghz or higher.

R\_Bus - 11 >> Distribution center

Requirement: Distribution center use encrypted connection to communicate with Virtual store and DDS.

Performance Requirement: The encryption must not delay the communication of Distribution center with Virtual store and DDS. It must be accomplished in less than 4 seconds.

Processor: Processor with 2.0 Ghz or higher.

R\_Bus - 12 >> Distribution center

Requirement: Distribution center is responsible to suggest the time for delivery, that will be chosen by a Customer. The suggestions are based on the list of free days to perform the delivery.

Performance Requirement: The Distribution center must be able to provide a list with suggestions in less than 2 seconds.

Processor: Processor with 2.0 Ghz or higher and 12 threads.

## Storage

R\_Bus - 13 >> Distribution center

Requirement: The Distribution center controls the registration of deliveries (providing the product and the Customer information such as the name and address) to be made and follows the delivery status.

Performance Requirement: All information received/sent by Distribution center must be stored for 10 years.

Storage: Each virtual machine must have 200 GB of storage.

## Customer

### Application

### Interface I/O

### Memory

R\_Bus - 14 >> Customer

Requirement: The communication link between Customer and Virtual store must be secure and encrypted.

Performance Requirement: The encryption must not affect the communication speed from Customer send a request or receive feedback.

Memory: 4 GB of RAM memory or higher.

R\_Bus - 15 >> Customer

Requirement: The Customers receive feedback about the delivery, also, the Customer may request to cancel a delivery until one hour before the plan to start the delivery, which may or

not be accepted by the Virtual store.

Performance Requirement: The Customer must have access to the update of delivery in real time.

Memory: 4 GB of RAM memory.

## Operating system

## Physical link

### R\_Bus - 16 >> Customer

Requirement: The Customer must be authenticated by Virtual store with strong password and support two factor authentication.

Performance Requirement: The Customer must take less than 10 seconds to accomplish the login with Virtual store.

Physical link: The connection must have a speed greater or equals to 5 MB download and 5 MB upload.

### R\_Bus - 17 >> Customer

Requirement: The communication link between Customer and Virtual store must be secure and encrypted.

Performance Requirement: The encryption must not affect the communication speed from Customer send a request or receive feedback.

Physical link: The connection must have a speed greater or equals to 5 MB download and 5 MB upload.

### R\_Bus - 18 >> Customer

Requirement: The Customers receive feedback about the delivery, also, the Customer may request to cancel a delivery until one hour before the plan to start the delivery, which may or not be accepted by the Virtual store.

Performance Requirement: The Customer must have access to the update of delivery in real time.

Physical link: The connection must have a speed greater or equals to 5 MB download and 5 MB upload.

## Processor

### R\_Bus - 19 >> Customer

Requirement: The Customer must be authenticated by Virtual store with strong password and support two factor authentication.

Performance Requirement: The Customer must take less than 10 seconds to accomplish the login with Virtual store.

Processor: Processor with 1.2 Ghz or higher.

### R\_Bus - 20 >> Customer

Requirement: The communication link between Customer and Virtual store must be secure and encrypted.

Performance Requirement: The encryption must not affect the communication speed from Customer send a request or receive feedback.

Processor: Processor with 1.2 Ghz or higher.

R\_Bus - 21 >> Customer

Requirement: The Customers receive feedback about the delivery, also, the Customer may request to cancel a delivery until one hour before the plan to start the delivery, which may or not be accepted by the Virtual store.

Performance Requirement: The Customer must have access to the update of delivery in real time.

Processor: Processor with 1.2 Ghz or higher.

Storage

## **DDS**

Application

R\_Bus - 22 >> DDS

Requirement: DDS must control the drone to fly to the destination and go back to the source.

Performance Requirement: DDS must use long-range and low-power consumption connection that supports the transfer of 256Kbits/s of data with each drone.

Application: DDS application must support LoRaWAN connection to communicate with Drone.

R\_Bus - 23 >> DDS

Requirement: The DDS is responsible for receiving and storing the delivery requests, receiving the products, controlling the enterprise drones (that make the delivery), and providing feedback to the Distribution center.

Performance Requirement: DDS is responsible for store the information about the delivery be stored for 5 years. It includes the client information, status, and drone telemetry.

Application: DDS application must never erase the logs.

R\_Bus - 24 >> DDS

Requirement: The DDS drones share the airspace with drones that do not belong to the enterprise. DDS uses a shared service to receives and share information (drone traffic, weather and others dangers to the drones) about the drones' flights with USS.

Performance Requirement: DDS must send the information in real time to the Drone. DDS system must send the control actions in real-time.

Application: Must support replication and have one instance dedicated to control Drones. The application must run on windows based operating systems.

R\_Bus - 25 >> DDS

Requirement: DDS aims to increase its efficiency in the delivery process, reducing costs and time. So is up to the DDS to determine a time to accomplish the delivery.

Performance Requirement: The Delivery center must delivery the purchase to DDS at least one day before the date of delivery to the customer.

Application: Run on Windows operating system and support replication.

R\_Bus - 26 >> DDS

Requirement: The DDS must plan the location to store the drones and products that will be delivered. The DDS must analyze the project viability of customer delivery.

Performance Requirement: DDS must have fast connection and fast communication protocol.

Application: DDS must support LoRaWAN protocol.

Interface I/O

#### R\_Bus - 27 >> DDS

Requirement: DDS must control the drone to fly to the destination and go back to the source.

Performance Requirement: DDS must use long-range and low-power consumption connection that supports the transfer of 256Kbits/s of data with each drone.

Interface I/O: LoRaWAN module and Drone.Internet connection.

#### R\_Bus - 28 >> DDS

Requirement: The DDS must plan the location to store the drones and products that will be delivered. The DDS must analyze the project viability of customer delivery.

Performance Requirement: DDS must have fast connection and fast communication protocol.

Interface I/O: LoRaWAN module connection.

#### R\_Bus - 29 >> DDS

Requirement: DDS is responsible to update the Drone operating system. Is desired that drones have the latest operating system.

Performance Requirement: The verification for system update must be weekly.

Interface I/O: Bluetooth 4.2.

### Memory

#### R\_Bus - 30 >> DDS

Requirement: After an emergency landing, a team must recover the drone according to the GPS position.

Performance Requirement: The Drone sends its location to the DDS after 5 seconds, and the DDS is responsible for store this information and sends it to the team that is responsible to recover the Drone.

Memory: Each Virtual Machine of DDS must have 8 GB of RAM or higher.

#### R\_Bus - 31 >> DDS

Requirement: The DDS drones share the airspace with drones that do not belong to the enterprise. DDS uses a shared service to receives and share information (drone traffic, weather and others dangers to the drones) about the drones' flights with USS.

Performance Requirement: DDS must send the information in real time to the Drone. DDS system must send the control actions in real-time.

Memory: Each Virtual Machine of DDS must have 8 GB of RAM or higher.

#### R\_Bus - 32 >> DDS

Requirement: The drone must never flight before the flight plan be approved by USS. Each flight registration requires the following information: the latitude and longitude of the takeoff and landing point, estimated time of takeoff and landing, maximum flight altitude, and maximum flight distance.

Performance Requirement: The information of flight plan must be processed by DDS according with informations provided by Distribution center and USS. It must take less than 10 seconds.

Memory: 8 GB of RAM memory.

#### R\_Bus - 33 >> DDS

Requirement: The access to USS occurs through an Application Programming Interface (API) using the internet. Only DDS is registered to access the USS.

Performance Requirement: DDS must have a fast link and high processor capacity to accomplish the requisition in less than 10 seconds.

Memory: 8 GB of RAM memory.



#### R\_Bus - 34 >> DDS

Requirement: DDS aims to increase its efficiency in the delivery process, reducing costs and time. So is up to the DDS to determine a time to accomplish the delivery.

Performance Requirement: The Delivery center must delivery the purchase to DDS at least one day before the date of delivery to the customer.

Memory: 8 GB of RAM.

#### Operating system

#### R\_Bus - 35 >> DDS

Requirement: The DDS drones share the airspace with drones that do not belong to the enterprise. DDS uses a shared service to receives and share information (drone traffic, weather and others dangers to the drones) about the drones' flights with USS.

Performance Requirement: DDS must send the information in real time to the Drone. DDS system must send the control actions in real-time.

Operating system: Must be Linux based, support Virtual Machine, and Shorewall firewall.

#### R\_Bus - 36 >> DDS

Requirement: DDS aims to increase its efficiency in the delivery process, reducing costs and time. So is up to the DDS to determine a time to accomplish the delivery.

Performance Requirement: The Delivery center must delivery the purchase to DDS at least one day before the date of delivery to the customer.

Operating system: Linux operating system.

#### Physical link

#### R\_Bus - 37 >> DDS

Requirement: DDS must control the drone to fly to the destination and go back to the source.

Performance Requirement: DDS must use long-range and low-power consumption connection that supports the transfer of 256Kbits/s of data with each drone.

Physical link: The physical link must have at least 400 MB download and 400 MB upload of link speed to Distribution center.

#### R\_Bus - 38 >> DDS

Requirement: After an emergency landing, a team must recover the drone according to the GPS position.

Performance Requirement: The Drone sends its location to the DDS after 5 seconds, and the DDS is responsible for store this information and sends it to the team that is responsible to recover the Drone.

Physical link: The communication link must have 400 MB download and 400 MB upload of link speed.

#### R\_Bus - 39 >> DDS

Requirement: The DDS drones share the airspace with drones that do not belong to the enterprise. DDS uses a shared service to receives and share information (drone traffic, weather and others dangers to the drones) about the drones' flights with USS.

Performance Requirement: DDS must send the information in real time to the Drone. DDS system must send the control actions in real-time.

Physical link: The communication link must have 400 MB download and 400 MB upload of link speed.

#### R\_Bus - 40 >> DDS

Requirement: DDS must also provide real-time delivery feedback to the customer through the

distribution center.

Performance Requirement: DDS must have an internet connection with the distribution center with adequate bandwidth.

Physical link: The communication link must have 400 MB download and 400 MB upload of link speed.

#### R\_Bus - 41 >> DDS

Requirement: The drone must never flight before the flight plan be approved by USS. Each flight registration requires the following information: the latitude and longitude of the takeoff and landing point, estimated time of takeoff and landing, maximum flight altitude, and maximum flight distance.

Performance Requirement: The information of flight plan must be processed by DDS according with informations provided by Distribution center and USS. It must take less than 10 seconds.

Physical link: The communication link must have 400 MB download and 400 MB upload of link speed.

#### R\_Bus - 42 >> DDS

Requirement: The access to USS occurs through an Application Programming Interface (API) using the internet. Only DDS is registered to access the USS.

Performance Requirement: DDS must have a fast link and high processor capacity to accomplish the requisition in less than 10 seconds.

Physical link: The communication link must have 400 MB download and 400 MB upload of link speed.

#### R\_Bus - 43 >> DDS

Requirement: DDS aims to increase its efficiency in the delivery process, reducing costs and time. So is up to the DDS to determine a time to accomplish the delivery.

Performance Requirement: The Delivery center must delivery the purchase to DDS at least one day before the date of delivery to the customer.

Physical link: The communication link must have 400 MB download and 400 MB upload of link speed.

#### R\_Bus - 44 >> DDS

Requirement: The DDS must plan the location to store the drones and products that will be delivered. The DDS must analyze the project viability of customer delivery.

Performance Requirement: DDS must have fast connection and fast communication protocol.

Physical link: The communication link must have 400 MB download and 400 MB upload of link speed.

#### R\_Bus - 45 >> DDS

Requirement: DDS is responsible to update the Drone operating system. Is desired that drones have the latest operating system.

Performance Requirement: The verification for system update must be weekly.

Physical link: Encrypted with AES 128.

### Processor

#### R\_Bus - 46 >> DDS

Requirement: After an emergency landing, a team must recover the drone according to the GPS position.

Performance Requirement: The Drone sends its location to the DDS after 5 seconds, and the DDS is responsible for store this information and sends it to the team that is responsible to recover the Drone.

Processor: Processor with 2.2 Ghz or higher.

#### R\_Bus - 47 >> DDS

Requirement: The DDS drones share the airspace with drones that do not belong to the enterprise. DDS uses a shared service to receives and share information (drone traffic, weather and others dangers to the drones) about the drones' flights with USS.

Performance Requirement: DDS must send the information in real time to the Drone. DDS system must send the control actions in real-time.

Processor: Processor with 2.2 Ghz or higher.

#### R\_Bus - 48 >> DDS

Requirement: The drone must never flight before the flight plan be approved by USS. Each flight registration requires the following information: the latitude and longitude of the takeoff and landing point, estimated time of takeoff and landing, maximum flight altitude, and maximum flight distance.

Performance Requirement: The information of fligh plan must be processed by DDS according with informations provided by Distribution center and USS. It must take less than 10 seconds.

Processor: Processor with 2.2 Ghz or higher.

#### R\_Bus - 49 >> DDS

Requirement: The access to USS occurs through an Application Programming Interface (API) using the internet. Only DDS is registered to access the USS.

Performance Requirement: DDS must have a fast link and high processor capacity to accomplish the requisition in less than 10 seconds.

Processor: Processor with 2.2 Ghz or higher.

#### R\_Bus - 50 >> DDS

Requirement: DDS aims to increase its efficiency in the delivery process, reducing costs and time. So is up to the DDS to determine a time to accomplish the delivery.

Performance Requirement: The Delivery center must delivery the purchase to DDS at least one day before the date of delivery to the customer.

Processor: Processor with 2.2 Ghz or higher.

## Storage

#### R\_Bus - 51 >> DDS

Requirement: The DDS is responsible for receiving and storing the delivery requests, receiving the products, controlling the enterprise drones (that make the delivery), and providing feedback to the Distribution center.

Performance Requirement: DDS is repensible for store the information about the delivery be stored for 5 years. It includes the client information, status, and drone telemetry.

Storage: 200 GB of storage for each Virtual Machine. The logs must be stored in a database using MySQL.

#### R\_Bus - 52 >> DDS

Requirement: The DDS must map several points for emegergency landing. Each drone must have this information stored and updated. In an emergency case the drone must be able to compute by itself the nearest emergency point.

Performance Requirement: DDS must provide to the drone a file with a map containing the region where drone operates. This map must have several emergency points to the Drone land. The file must have less than 8 GB of size.

Storage: The size of map must be under 8 GB of storage.

#### R\_Bus - 53 >> DDS

Requirement: The DDS is characterized as the overall manager, by controlling the entire

delivery process (including putting the product in the drone), from receiving and delivery requests, defining routes, managing the flight plan, drone maintenance, updating delivery status, and storing the flight information.

Performance Requirement: All the information sent/received by DDS must be stored for 5 years. Each virtual machine must sync the logs with DDS system.

Storage: 2 TB of shared storage for logs.

## **Virtual store**

### **Application**

R\_Bus - 54 >> Virtual store

Requirement: Virtual store must have replication to attend the Customer demands.

Performance Requirement: Virtual store application must support several instances and use scalable VM as replication.

Application: Application must support replication.

R\_Bus - 55 >> Virtual store

Requirement: Virtual store have an authentication to communicate with the Customer and Distribution center.

Performance Requirement: The authentication method for Customer and Distribution center are distinct and must take less than 3 seconds.

Application: The application must use user and password to authenticate the Customer. The password must require letters, numbers, and special characters.

R\_Bus - 56 >> Virtual store

Requirement: Virtual store use encrypted connection to communicate with Customer and Distribution center.

Performance Requirement: The communication protocol must be encrypted and do not affects the time to send data.

Application: Support HTTPS protocol.

### **Interface I/O**

### **Memory**

R\_Bus - 57 >> Virtual store

Requirement: Virtual store must have replication to attend the Customer demands.

Performance Requirement: Virtual store application must support several instances and use scalable VM as replication.

Memory: 8 GB or RAM memory.

R\_Bus - 58 >> Virtual store

Requirement: The Customer will consume the system services, in this case: purchase the product, send the address coordinates to the DDS to locate the customer and send the drone, and receive the product. The Customer has no control over the system, the Customer only aims to receive his product in a faster and more reliable way, with a better follow-up of the delivery process.

Performance Requirement: The Virtual store must be available full time and have scalable application in order to attend the Customers requisitions.

Memory: 8 GB of RAM memory.

## Operating system

R\_Bus - 59 >> Virtual store

Requirement: Virtual store must have replication to attend the Customer demands.

Performance Requirement: Virtual store application must support several instances and use scalable VM as replication.

Operating system: Windows server operating system that supports the use of scalable VM.

R\_Bus - 60 >> Virtual store

Requirement: The Customer will consume the system services, in this case: purchase the product, send the address coordinates to the DDS to locate the customer and send the drone, and receive the product. The Customer has no control over the system, the Customer only aims to receive his product in a faster and more reliable way, with a better follow-up of the delivery process.

Performance Requirement: The Virtual store must be available full time and have scalable application in order to attend the Customers requisitions.

Operating system: Windows server operating system that supports Virtual Machine to replicate the application.

## Physical link

R\_Bus - 61 >> Virtual store

Requirement: The Virtual store have more than one link for internet connection.

Performance Requirement: Each internet connection link is able to support all the customers requisitions.

Physical link: Each link must have 300 MB download and 300 MB upload speed.

R\_Bus - 62 >> Virtual store

Requirement: Virtual store have an authentication to communicate with the Customer and Distribution center.

Performance Requirement: The authentication method for Customer and Distribution center are distinct and must take less than 3 seconds.

Physical link: Each link must have 300 MB download and 300 MB upload speed.

R\_Bus - 63 >> Virtual store

Requirement: Virtual store use encrypted connection to communicate with Customer and Distribution center.

Performance Requirement: The communication protocol must be encrypted and do not affects the time to send data.

Physical link: Each link must have 300 MB download and 300 MB upload speed.

R\_Bus - 64 >> Virtual store

Requirement: Virtual store only follows the delivery update provided by Delivery center. Virtual store aims to get more follow-up and reliability in the delivery process, aiming at customer satisfaction.

Performance Requirement: Virtual store must have an alternative link in case of lose the primary link. The link must be up full time.

Physical link: Each link must have 300 MB download and 300 MB upload speed.

R\_Bus - 65 >> Virtual store

Requirement: The Customer will consume the system services, in this case: purchase the product, send the address coordinates to the DDS to locate the customer and send the drone, and receive the product. The Customer has no control over the system, the Customer only aims to receive his product in a faster and more reliable way, with a better follow-up of the delivery process.

Performance Requirement: The Virtual store must be available full time and have scalable application in order to attend the Customers requisitions.

Physical link: Each link must have 300 MB download and 300 MB upload speed.

## Processor

R\_Bus - 66 >> Virtual store

Requirement: Virtual store must have replication to attend the Customer demands.

Performance Requirement: Virtual store application must support several instances and use scalable VM as replication.

Processor: Processor with 2.0 Ghz or higher.

R\_Bus - 67 >> Virtual store

Requirement: The Customer will consume the system services, in this case: purchase the product, send the address coordinates to the DDS to locate the customer and send the drone, and receive the product. The Customer has no control over the system, the Customer only aims to receive his product in a faster and more reliable way, with a better follow-up of the delivery process.

Performance Requirement: The Virtual store must be available full time and have scalable application in order to attend the Customers requisitions.

Processor: Processor with 1.8 Ghz.

## Storage

R\_Bus - 68 >> Virtual store

Requirement: The Customer will consume the system services, in this case: purchase the product, send the address coordinates to the DDS to locate the customer and send the drone, and receive the product. The Customer has no control over the system, the Customer only aims to receive his product in a faster and more reliable way, with a better follow-up of the delivery process.

Performance Requirement: The Virtual store must be available full time and have scalable application in order to attend the Customers requisitions.

Storage: Each Virtual Machine must have 50 GB of storage.

## Drone

### Application

### Interface I/O

R\_Bus - 69 >> Drone

Requirement: After take-off, the drone sends periodically status to the DDS about its position

and drone status information, including changes in the route, or hazardous situations (e.g., bad weather conditions) that make difficult or make impossible the drone flight.  
Performance Requirement: Drone must send its status to the DDS each 5 seconds after start a delivery.

Interface I/O: Cellphone network connection to positioning system and LoRaWAN module and module connection to send/receive information.

R\_Bus - 70 >> Drone

Requirement: In cases of hazardous situations (e.g. strong wind), the delivery may be canceled (so the drone returns to the origin Delivery Center). Drone must be able to identify hazardous situations by itself.

Performance Requirement: Drone is fully autonomous and must be able to operate by itself to accomplish the delivery or return to the base.

Interface I/O: LoRaWAN module and mobile network connection.

R\_Bus - 71 >> Drone

Requirement: In cases of hazardous situations (e.g. strong wind or sudden change in the weather forecast ), the DDS will send a command to the drone to go to another GPS position (an emergency place to land the drone) that is safe to the drone lands.

Performance Requirement: This updates for forecast and the control action to the drone must be in real time.

Interface I/O: LoRaWAN network connection.

R\_Bus - 72 >> Drone

Requirement: Drone must have a positioning accuracy under 10 meters.

Performance Requirement: Drone position accuracy must be less than 10 meters.

Interface I/O: 4G Cellphone network connection and GPS connection (compatible with GLONASS/BeiDou/Galileo).

R\_Bus - 73 >> Drone

Requirement: Each drone must have and internet connection to send and receive communication with DDS. The drone communication must occurs only with DDS.

Performance Requirement: The communication must be fast, reliable, and supports data with 5 MB.

Interface I/O: Mobile network connection.

R\_Bus - 74 >> Drone

Requirement: The software or protocol chosen to be used in the drone must have low consumption of battery energy.

Performance Requirement: The drone software and protocols must be efficient in battery consumption and make efficient use of the processor.

Interface I/O: LoRaWAN module connection.

R\_Bus - 75 >> Drone

Requirement: Drone must use software and protocols focused for IoT.

Performance Requirement: The operating system and protocols must be optimized for low battery consumption.

Interface I/O: LoRaWAN module connection.

R\_Bus - 76 >> Drone

Requirement: The Drones accepts only one size box to make delivery, only carry boxes weighing less than 5 pounds (approximately 2.2 Kg), and make delivery up to 3 kilometers in diameter.

Performance Requirement: Drone must be able to control itself and send the information and telemetry to DDS every 5 seconds.

Interface I/O: LoRaWAN and cellphone network connection.

## Memory

### R\_Bus - 77 >> Drone

Requirement: In cases of hazardous situations (e.g. strong wind), the delivery may be canceled (so the drone returns to the origin Delivery Center). Drone must be able to identify hazardous situations by itself.

Performance Requirement: Drone is fully autonomous and must be able to operate by itself to accomplish the delivery or return to the base.

Memory: 1,5 GB of RAM memory.

### R\_Bus - 78 >> Drone

Requirement: The software or protocol chosen to be used in the drone must have low consumption of battery energy.

Performance Requirement: The drone software and protocols must be efficient in battery consumption and make efficient use of the processor.

Memory: 1,5 GB of RAM memory.

### R\_Bus - 79 >> Drone

Requirement: The Drones accepts only one size box to make delivery, only carry boxes weighing less than 5 pounds (approximately 2.2 Kg), and make delivery up to 3 kilometers in diameter.

Performance Requirement: Drone must be able to control itself and send the information and telemetry to DDS every 5 seconds.

Memory: 1,5 GB of RAM memory.

### R\_Bus - 80 >> Drone

Requirement: During the hovering process, the Drone get closes to the ground to safe releases the payload. The process to release the payload consists in open the compartment and the box comes out of the compartment smoothly.

Performance Requirement: Drone algorithm must be able to control the Drone during the hovering process to indentify the QR code, identify the ground distance, and release the package at same time.

Memory: 1,5 GB of RAM memory.

### R\_Bus - 81 >> Drone

Requirement: If the Drone does not recognize the customer QR code after hovering for 3 minutes, the drone returns to the DDS with the payload.

Performance Requirement: Drone algorithm must be able to control the Drone during the hovering process, indentify the QR code, identify the ground distance, and release the package at same time. Drone must have a reliable operating system, and reliable components.

Memory: 1,5 GB of RAM memory.

## Operating system

### R\_Bus - 82 >> Drone

Requirement: After take-off, the drone sends periodically status to the DDS about its position and drone status information, including changes in the route, or hazardous situations (e.g., bad weather conditions) that make difficult or make impossible the drone flight.

Performance Requirement: Drone must send its status to the DDS each 5 seconds after start a delivery.

Operating system: The operating system is VOTIX FLY which supports 4G connection. The communication protocol is LoRaWAN module and .



R\_Bus - 83 >> Drone

Requirement: In cases of hazardous situations (e.g. strong wind), the delivery may be canceled (so the drone returns to the origin Delivery Center). Drone must be able to identify hazardous situations by itself.

Performance Requirement: Drone is fully autonomous and must be able to operate by itself to accomplish the delivery or return to the base.

Operating system: The operating system is VOTIX FLY which supports 4G and LoRaWAN module connection.

R\_Bus - 84 >> Drone

Requirement: The software or protocol chosen to be used in the drone must have low consumption of battery energy.

Performance Requirement: The drone software and protocols must be efficient in battery consumption and make efficient use of the processor.

Operating system: The operating system is VOTIX FLY which supports 4G connection. The communication protocol is ZigBee.

R\_Bus - 85 >> Drone

Requirement: Drone must use software and protocols focused for IoT.

Performance Requirement: The operating system and protocols must be optimized for low battery consumption.

Operating system: The operating system is VOTIX FLY which supports 4G connection. The communication protocol is LoRaWAN.

R\_Bus - 86 >> Drone

Requirement: The Drones accepts only one size box to make delivery, only carry boxes weighing less than 5 pounds (approximately 2.2 Kg), and make delivery up to 3 kilometers in diameter.

Performance Requirement: Drone must be able to control itself and send the information and telemetry to DDS every 5 seconds.

Operating system: The operating system is VOTIX FLY which supports 4G connection. The communication protocol is LoRaWAN.

R\_Bus - 87 >> Drone

Requirement: The Drone autonomously flies, identifies, and delivers a product to a customer. We assume that the process where an operator put the package into the drone and the process to release (deliver) the payload, are reliable and have been previously analyzed since they are not the focus of this analysis.

Performance Requirement: Drone must have a technology for Collision Avoidance System to assist the flight.

Operating system: The operating system is VOTIX FLY which supports 4G connection and have a Collision Avoidance System.

R\_Bus - 88 >> Drone

Requirement: Drone must have the latest operating system updates.

Performance Requirement: Drone operating system must have long time support.

Operating system: The operating system is VOTIX FLY.

## Physical link

R\_Bus - 89 >> Drone

Requirement: After take-off, the drone sends periodically status to the DDS about its position and drone status information, including changes in the route, or hazardous situations (e.g., bad weather conditions) that make difficult or make impossible the drone flight.

Performance Requirement: Drone must send its status to the DDS each 5 seconds after start a delivery.

Physical link: 4G connection or higher with cellphone and LoRaWAN network.

R\_Bus - 90 >> Drone

Requirement: In cases of hazardous situations (e.g. strong wind), the delivery may be canceled (so the drone returns to the origin Delivery Center). Drone must be able to identify hazardous situations by itself.

Performance Requirement: Drone is fully autonomous and must be able to operate by itself to accomplish the delivery or return to the base.

Physical link: 10MB for upload and 10MB for download.

R\_Bus - 91 >> Drone

Requirement: In cases of hazardous situations (e.g. strong wind or sudden change in the weather forecast ), the DDS will send a command to the drone to go to another GPS position (an emergency place to land the drone) that is safe to the drone lands.

Performance Requirement: This updates for forecast and the control action to the drone must be in real time.

Physical link: LoRaWAN module.

R\_Bus - 92 >> Drone

Requirement: Drone must have a positioning accuracy under 10 meters.

Performance Requirement: Drone position accuracy must be less than 10 meters.

Physical link: The Cellphone link is 4G or higher. The GPS link is Glonass

R\_Bus - 93 >> Drone

Requirement: Each drone must have and internet connection to send and receive communication with DDS. The drone communication must occurs only with DDS.

Performance Requirement: The communication must be fast, reliable, and supports data with 5 MB.

Physical link: 4G or higher.

R\_Bus - 94 >> Drone

Requirement: The software or protocol chosen to be used in the drone must have low consumption of battery energy.

Performance Requirement: The drone software and protocols must be efficient in battery consumption and make efficient use of the processor.

Physical link: LoRaWAN network.

R\_Bus - 95 >> Drone

Requirement: Drone must use software and protocols focused for IoT.

Performance Requirement: The operating system and protocols must be optimized for low battery consumption.

Physical link: LoRaWAN network.

R\_Bus - 96 >> Drone

Requirement: The Drones accepts only one size box to make delivery, only carry boxes weighing less than 5 pounds (approximately 2.2 Kg), and make delivery up to 3 kilometers in diameter.

Performance Requirement: Drone must be able to control itself and send the information and telemetry to DDS every 5 seconds.

Physical link: 10MB of download and 10MB of upload.

Processor

R\_Bus - 97 >> Drone

Requirement: After take-off, the drone sends periodically status to the DDS about its position and drone status information, including changes in the route, or hazardous situations (e.g., bad weather conditions) that make difficult or make impossible the drone flight.

Performance Requirement: Drone must send its status to the DDS each 5 seconds after start a delivery.

Processor: ARM with 1.5 Ghz.

R\_Bus - 98 >> Drone

Requirement: In cases of hazardous situations (e.g. strong wind), the delivery may be canceled (so the drone returns to the origin Delivery Center). Drone must be able to identify hazardous situations by itself.

Performance Requirement: Drone is fully autonomous and must be able to operate by itself to accomplish the delivery or return to the base.

Processor: ARM with 1.5 Ghz.

R\_Bus - 99 >> Drone

Requirement: In cases of hazardous situations (e.g. strong wind or sudden change in the weather forecast ), the DDS will send a command to the drone to go to another GPS position (an emergency place to land the drone) that is safe to the drone lands.

Performance Requirement: This updates for forecast and the control action to the drone must be in real time.

Processor: ARM with 1.5 Ghz.

R\_Bus - 100 >> Drone

Requirement: Drone must have a positioning accuracy under 10 meters.

Performance Requirement: Drone position accuracy must be less than 10 meters.

Processor: ARM with 1.5 Ghz.

R\_Bus - 101 >> Drone

Requirement: Each drone must have and internet connection to send and receive communication with DDS. The drone communication must occurs only with DDS.

Performance Requirement: The communication must be fast, reliable, and supports data with 5 MB.

Processor: ARM with 1.5 Ghz.

R\_Bus - 102 >> Drone

Requirement: The software or protocol chosen to be used in the drone must have low consumption of battery energy.

Performance Requirement: The drone software and protocols must be efficient in battery consumption and make efficient use of the processor.

Processor: ARM with 1.5 Ghz.

R\_Bus - 103 >> Drone

Requirement: The Drones accepts only one size box to make delivery, only carry boxes weighing less than 5 pounds (approximately 2.2 Kg), and make delivery up to 3 kilometers in diameter.

Performance Requirement: Drone must be able to control itself and send the information and telemetry to DDS every 5 seconds.

Processor: ARM with 1.5 Ghz.

R\_Bus - 104 >> Drone

Requirement: During the hovering process, the Drone get closes to the ground to safe releases the payload. The process to release the payload consists in open the compartment and the box comes out of the compartment smoothly.

Performance Requirement: Drone algorithm must be able to control the Drone during the hovering process to identify the QR code, identify the ground distance, and release the package at same time.

Processor: ARM with 1.5 Ghz.

R\_Bus - 105 >> Drone

Requirement: The Drone autonomously flies, identifies, and delivers a product to a customer. We assume that the process where an operator put the package into the drone and the process to release (deliver) the payload, are reliable and have been previously analyzed since they are not the focus of this analysis.

Performance Requirement: Drone must have a technology for Collision Avoidance System to assist the flight.

Processor: ARM with 1.5 Ghz.

R\_Bus - 106 >> Drone

Requirement: If the Drone does not recognize the customer QR code after hovering for 3 minutes, the drone returns to the DDS with the payload.

Performance Requirement: Drone algorithm must be able to control the Drone during the hovering process, identify the QR code, identify the ground distance, and release the package at same time. Drone must have a reliable operating system, and reliable components.

Processor: ARM with 1.5 Ghz.

## Storage

R\_Bus - 107 >> Drone

Requirement: Each Drone has a Remote Identification (RID), which is registered at USS. The system must use the RID to identify each drone.

Performance Requirement: The drone RID must be also stored in the DDS database.

Storage: 10 GB of storage.

R\_Bus - 108 >> Drone

Requirement: Drone must have the latest operating system updates.

Performance Requirement: Drone operating system must have long time support.

Storage: 64 GB of storage.

## Performance

### Distribution center

RQ-1: Application >> (Conflict) Distribution center application must accept only JSON files, use HTTPS with SSL/TLS, run on Linux systems, use Log4j 2, asymmetric encryption as a second way of authentication, and replication. Support authentication method using user + password.

RQ-2: Interface I/O >> Support one HPE Ethernet 10/25Gb 2 ports 10/100/1000.

RQ-3: Memory >> The system must have 8 GB of RAM memory or higher.

RQ-4: Operating system >> (Conflict) The operating system must be Linux based with long-term support, supporting Virtual Machines, and having a firewall. The firewall must limit

that application send/receive only JSON files.

RQ-5: Physical link >> (Conflict) Distribution center must have 400 Mbps upload and 400 Mbps download of speed or higher.

RQ-6: Processor >> (Conflict) Processor with 2.0 Ghz or higher and 12 threads.

RQ-7: Storage >> (Conflict) Each virtual machine must have 200 GB of storage.

## **Customer**

RQ-8: Application >> (Conflict) To solve the conflict the Customer must use HTTPS protocol for accomplish the communication in fast way and be fast.

RQ-9: Memory >> Customer must have 4 GB of RAM memory or higher to interact with Virtual store.

RQ-10: Physical link >> Customer must have at least 5 Mbps download and 5 Mbps upload of connection link speed.

RQ-11: Processor >> Customer must have a processor with 1.6 Ghz or higher.

RQ-12: Physical link >> Virtual store must have 500 Mbps download and 500 Mbps upload.

## **DDS**

RQ-13: Application >> (Conflict) Application must support replication and be scalable, support JSON, Log4j 2, run in a Virtual Machine with linux based systems. DDS application must support HTTPS with SSL/TLS to communicate with USS and Distribution center, support ZigBee to communicate with Drone Application must support digital signatures based on assymetric encryption. Application is also reponsible to validate the JSON files. Application must have an authentication method using user + password. Application must enforce the password. DDS must have at least 3 instances of application. One instance of application must deal with drones, one to the Distribution center, and one to USS. Application must use AES 256 and bluetooth to update the Drone operating system.

RQ-14: Memory >> DDS RAM memory is 8 GB.

RQ-15: Operating system >> (Conflict) Linux based operating system with long-term support and supporting scalable Virtual Machine. Support the Shorewall firewall to limit the communication to JSON files and limit the connection intentions. The operating system and implement the role-based access.

RQ-16: Physical link >> (Conflict) Dual link for internet connection. Each link (primary and secondary) must have 400 Mbps download and 400 Mbps upload of speed.

RQ-17: Processor >> (Conflict) Multithread processor (Quad core or higher) with 2.2 Ghz.

RQ-18: Storage >> (Conflict) 200 GB of storage for each Virtual Machine. 2 TB of shared storage for logs. The logs must be stored in a database using MySQL.

RQ-19: Interface I/O >> (Conflict) The interface that DDS use to update the operating system of drone is Bluetooth 5.0. The DDS uses internet connection to control the drones.

RQ-20: Memory >> Drone RAM memory is 8 GB or higher.

RQ-21: Operating system >> Drone operating system is FlytOS which supports HTTPS.

RQ-22: Physical link >> Drone physical link must have 24 Mbps or more.

## **Virtual store**

RQ-23: Application >> (Conflict) The Virtual store application must run on the 3 most used internet browsers. Support HTTPS protocol with SSL/TSL, JSON standard, have and authentication method based on user + password. The password must require letters, numbers, and special characters. The application must also support replication.

RQ-24: Interface I/O >> The connection must be HPE Ethernet 10/25Gb and 2 ports 10/100/1000.

RQ-25: Memory >> (Conflict) Virtual store must have 8 GB of RAM memory or higher.

RQ-26: Operating system >> (Conflict) Virtual store operating system must be Linux based, support the use of Virtual Machines, have replication of the application, and have a firewall. The firewall must limit the communication to accept only JSON files and limit the connection intentions from Customer and Distribution center.

RQ-27: Physical link >> (Conflict) The primary and the secondary connection link must have 400 Mbps download and 400 Mbps upload of speed.

RQ-28: Processor >> (Conflict) Support dual and scalable processor with 1.8 Ghz or higher

RQ-29: Storage >> (Conflict) Each instance of application running on a Virtual Machine must have at least 50 GB of storage.

## **Drone**

RQ-30: Interface I/O >> (Conflict) Cellphone network connection (4G or higher) and GPS connection (compatible with GLONASS/BeiDou/Galileo) and compatible with A-GPS.

RQ-31: Memory >> (Reinforcement) 1,5 GB of RAM memory.

RQ-32: Operating system >> (Conflict) The operating system must be FlytOS. Support cellphone network connection, GPS connection, A-GPS technology, Log4j 2, JSON, SQLite Encryption Extension (SEE), HTTPS protocol, and operating system updates. The system must have authentication method requiring user and strong password, the authentication process must be accomplished in less than 1 second. Operating system must also have a Collision Avoidance System.

RQ-33: Physical link >> (Conflict) 4G or higher connection for cellphone network and glonass for GPS. DDS minimum link speed is 10 Mbps download and 10 Mbps upload of link speed.

RQ-34: Processor >> (Conflict) ARM with 1.5 Ghz.

RQ-35: Storage >> 64 GB of storage.