

## Appendix 1 – Technical Specifications

### Enclosed to Invitation to tender for procurement procedure No. EMSA/OP/2/2018 concerning *Contract for provision of SATCOM services for RPAS*

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## 1 Contract modules activities

The detailed activities to be implemented for each one of contract modules are described in the sections below.

### 1.1 Lots 1,2

#### 1.1.1 Module\_01: Service set-up.

1.1.1.1 The service set-up comprises the following activities:

Support to the setup of the SATCOM terminal at the disposal of EMSA's RPAS services providers

- **Installation and configuration of the SATCOM terminal on the RPAS platform**

A RPAS platform survey will be conducted prior to the installation to ensure that the SATCOM terminal can operate properly in coexistence with rest of the RPAS systems (RFI test, power supply, interfaces with the payload sensors, etc.)

The SATCOM terminal will have to be mounted with sufficient physical separation between the antenna and all communication, navigation and sensor systems. The antenna installation should guarantee a clear line of sight path to the satellite with the highest amount of unobstructed view to the horizon.

The Contractor shall perform the configuration of the terminal settings to guarantee the correct performance with the satellite or satellites chosen for the service provision: frequency adjustment, satellite beam management, satellite tracking, modem settings, etc.

Set-up of the SATCOM communication link

- **Connection to Satellite Service Provider's server**

- network connection interfaces
- IP addresses

- **Characterization of the SATCOM service performance**

After the first service set-up an end-to-end acceptance test must be performed to ensure the fulfilment of the Contracting Authority's requirements:

- latency
- EIRP, G/T, C/N, C/N0, SNR, Eb/N0 level at Ground Station
- EIRP, G/T, C/N, C/N0, SNR, Eb/N0 at SATCOM terminal
- EIRP, G/T, C/N, C/N0, SNR, Eb/N0 at satellite
- Effective bit data rate
- BER
- packet loss rate

- **Provision of SATCOM capacity during the set-up phase**

During the set-up phase the SATCOM capacity provision must be made available to the RPAS Services Providers in order to conduct all the necessary configuration tests.

Prior to the start of the first RPAS operations a minimum of 100 flight hours are compulsory to guarantee the readiness of the system, SATCOM provision shall be granted for all the test flights requiring BRLOS communications.

### 1.1.2 **Module\_02: SATCOM capacity provision**

1.1.2.1 For the SATCOM capacity provision module the Contractor shall provide the following services:

- **Provide end-to-end SATCOM services**

- 2-way (forward and return) SATCOM Command and Control link
- 1-way SATCOM (return) payload data link with the data rate specified for each one of the Lots
- backup link for Command and Control in case of unavailability of the primary link

- **Define the baseline of the service utilisation**

The baseline of the service utilization must include the following service agreement parameters: volume of data exchanged, data rate, mission coverage area and service planning.

- **Supply of Space Segment**

Satellite or satellites.

- **Supply Ground Segment**

Ground station, gateway, teleport, etc.

- **Network connectivity management**

The Contractor shall guarantee that its network provides:

- download and upload connection speed (from the Contractor to the end user)
- traffic management policies

- **Short time for service implementation**

- **Contract information access**

Provide instant on-line access to all contract information and historical service data logs.

- **Notification of contract expiry**

Provide notification of contract expiry and possibility of auto-renewal (2+1+1 year).

- **QoS (Quality of Service)**

The following QoS elements must be ensured:

- coverage over service agreement areas
- packet loss rate
- latency
- jitter
- data rate
- availability
- Eb/No required to reach target BER for the modulation and coding scheme selected

- **Service reporting**

The Contractor shall provide the Contracting Authority with a monthly service report covering all the activities and services covered under the Specific Contract (SC). The monthly report shall contain at least the following information:

- data volume consumption for billing purposes
- service configuration (satellite, teleport, frequency, etc.)
- QoS (packet loss rate, latency, jitter, etc.)

### 1.1.3 **Module\_03: Service maintenance**

1.1.3.1 The service maintenance should cover the following aspects:

- **First level support**

- “On-Call Service” available 24/7
- capture all incidents and provide the appropriate responses
- logging incidents (calls, requests, etc.) accurately into a Ticket System
- giving operational status information to the Contracting Authority and to the RPAS team on site

- **Preventive maintenance**

Preventive maintenance includes the following tasks:

- servicing, handling and periodic inspections of the all service related components
- periodic calibration of equipment
- repairs and minor adjustments that do not require shop facilities

- **Corrective maintenance<sup>1</sup>**

Corrective maintenance includes the following tasks:

- purchasing, storage and inventory control of spare parts

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<sup>1</sup> Corrective maintenance of the SATCOM terminal is just applicable if there is a there is a leasing contract in place between the Contractor and the RPAS Services Provider.

- shop-type repair and test work on all related components and equipment
- shipment to the supplier and repair of faulty equipment that cannot be satisfactorily repaired on site
- completion of maintenance activity reports for each failure that has occurred

## 1.2 Lot 3

### 1.2.1 Module\_01: Service set-up

1.2.1.1 The service set-up comprises the following activities:

- **Installation and configuration of the VSAT and communication equipment**

The Contractor shall mount the VSAT and all necessary communication equipment on the operations site. The installation and configuration must guarantee the correct operation with the satellites chosen for the service provision: frequency adjustment, satellite beam management, satellite tracking, modem settings, etc.

The software configuration and the management of the interfaces with the LGCS equipment should be part of the service set-up.

- **Connection to Satellite Service Provider's server**

- network connections interfaces
- IP addresses

- **Performance test of the satellite internet service**

After the service set-up the Contractor must provide records that ensure that the system is compliant with the Contracting Authority's specifications. The following information shall be made available:

- VSAT pointing accuracy test
- VSAT wind stability test
- received signal level at ground station
- transmitted received signal level at VSAT
- packet loss rate
- network throughput (upload/download effective data rate)
- latency
- jitter
- percentage of network availability
- EIRP, G/T, C/N0, SNR, Eb/N0 level at ground station
- EIRP, G/T, C/N0, SNR, Eb/N0 at VSAT

## 1.2.2 **Module\_02: Satellite internet capacity provision**

1.2.2.1 For the satellite internet capacity provision module the Contractor shall provide the following services:

- **Provide end-to-end satellite internet service**

Satellite internet connection from/to the LGCS (Local Ground Control Station) and the CGCS (Central Ground Control Station) and/or the RPAS-DC (RPAS Data Center).

- upstream traffic for BRLOS and RLOS payload data link
- upstream/downstream for Command and Control link, both for RLOS and BRLOS

- **Define the baseline of the service utilisation**

The baseline of the service utilization must include the following service agreement parameters: available bandwidth, effective data rate, mission coverage area and service planning.

- **Service subscription prices**

It will be based on a pre-agreed monthly subscription fee price for the internet service.

- **Supply of Space Segment**

Satellite or satellites.

- **Supply Ground Segment**

VSAT, ground station, gateway, teleport, etc.

- **Network connectivity management**

The Contractor shall guarantee that its network provides:

- download and upload connection speed (from the Contractor to the end user)
- traffic management policies

- **Short time for service implementation**

- **Contract information access**

Provide instant on-line access to all contract information and historical service data logs.

- **Notification of contract expiry**

Provide notification of contract expiry and possibility of auto-renewal of contracts (2+1+1 year).

- **QoS (Quality of Service)**

The following QoS elements must be ensured:

- packet loss rate
- latency
- jitter
- effective network throughput (upload/download data rate)
- availability

- **Service reporting**

The Contractor shall provide the Contracting Authority with a monthly service report covering all the services and activities covered under the SC. The monthly report shall contain the following information:

- service configuration (satellite, teleport, frequency, etc.)
- QoS (packet loss rate, latency, jitter, etc.)

### 1.2.3 **Module\_03: Service maintenance**

1.2.3.1 The service maintenance should cover the following aspects:

- **First level support**

- “On-Call Service” available 24/7
- capture all incidents and provide the appropriate responses
- logging incidents (calls, requests, etc.) accurately into a Ticket System
- giving operational status information to the Contracting Authority and to the RPAS team on-site

- **Preventive maintenance**

Preventive maintenance includes the following tasks:

- servicing, handling and periodic inspections of all related equipment and associated tests
- periodic calibration of equipment
- repairs and minor adjustments that do not require shop facilities

- **Corrective maintenance**

Corrective maintenance includes the following tasks:

- purchasing, storage and inventory control of spare parts.
- shop-type repair and test work on all related components and equipment
- shipment to the supplier and repair of faulty equipment that cannot be satisfactorily repaired on site

#### 1.2.4 **Module\_04: VSAT leasing**

1.2.4.1 The VSAT and communication equipment leasing should cover the following aspects:

- **Leasing conditions**

The leasing period shall cover all time consumed in transporting the equipment, including the date of legal delivery and return of the equipment.

The maximum time for transportation of the equipment to the operations site should not exceed in any case two weeks.

A warranty agreement and proof of leasing must be signed both by the Contractor and the Contracting authority.

- **Maintenance**

During the duration of the leasing the Contractor shall be responsible for VSAT and communication equipment maintenance and repair activities.

- **Inventory list**

The Contractor shall provide the complete list of items leased under the SC.



## 2 Requirements

The typical scenario to be considered for RPAS operations requiring SATCOM services is the following:

### RPAS operations scenario:

Estimated monthly flight hours per SC	<b>200 hours</b>
RPAS flight endurance	<b>8 to 10 hours</b> (SATCOM service must be available during the whole duration of the flight)
Frequency of RPAS flights	<b>1 flight per day</b> (SATCOM service must be available during the whole flight)
Daytime/Night-time	Daytime and nighttime operational capability
Indicative percentage of flight time under BRLOS	<b>50%</b>
Beyond Radio Line of Sight (BRLOS) range	<b>&gt;500km</b>

### 2.1 Lots 1, 2: SATCOM general service requirements

2.1.1 The general requirements applicable to Lots 1,2: are listed below:

#### General service requirements:

Coverage Area	Satellite coverage areas must be all sea areas surrounding the European Union with an EU or EFTA country	Mandatory
	If requested by governmental users, the SATCOM service could be extended outside EU adjacent sea basins	Mandatory
	Cross border operations can be included. Starting point can be any EU/EFTA country	Mandatory
BRLOS maximum latency	<b>&lt;2s</b>	Mandatory

SATCOM supported links	Payload data link, housekeeping and metadata information Command and Control link (primary and backup)	Mandatory
Command and Control link data rate	<b>54 to 256 Kbps</b>	Mandatory
Command and Control link availability	<b>&gt;99.99%</b>	Mandatory
HD video standard	STANAG 4609 standard (H.264), the protocol for video/metadata streaming shall be MPEG2TS	Mandatory
Contention ratio	Uncontended or very low	Advantage
Protocols	TCP/IP, UDP	Mandatory
Satellite payload link broadcasting standard	DVB-S2, DVB-S2X	Advantage
Modulation scheme	QPSK, 8PSK, 16APS, 32APS, 64 APSK, 128 APSK, 256APSK	Advantage
FEC (forward error correction)	LDPC+ BCH 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10	Advantage
BER for Payload data link	$<1 \times 10^{-5}$	Mandatory

## 2.2 Lot 1: SATCOM services (≥2Mbps)

2.2.1 For Lot 1 the general SATCOM service requirements are applicable. The specific requirements for this lot are listed below:

### Lot 1 specific service requirements:

SATCOM service bandwidth	<p>The SATCOM service bandwidth shall allow to transmit at least <b>one MPEG2TS stream</b> (EO, IR, SAR and radar sensors, etc.), Command and Control link and metadata information</p> <p>Mandatory</p>
SATCOM service effective data rate	<p>The minimum data rate of the return link shall be <b>≥2Mbps</b></p> <p>Mandatory</p> <p>The minimum data rate of the forward link shall be enough to transmit the Command and Control link and the payload data link shall transmit <u>at least one stream</u> with the below mentioned resolution:</p> <ul style="list-style-type: none"> <li>• compressed video stream with a video resolution of <b>720x576, 1024x768 or 1920 x 1025 @10fps</b> (this fps value is indicative)</li> <li>• IR sensor stream with at least <b>700 pixels</b> in one dimension</li> <li>• Maritime radar sensor data</li> <li>• SAR sensor data</li> <li>• in parallel to the video stream with the above mentioned resolution the system shall be able to transmit an <b>image</b> with a resolution of at least <b>2 megapixel every second</b></li> <li>• all flight, <b>housekeeping</b> and <b>metadata</b> needed to fully characterize the data received (e.g. georeferenciation)</li> </ul>

### 2.3 Lot 2: SATCOM services (≥5Mbps)

For Lot 2 the general SATCOM service requirements are applicable. The specific requirements for this lot are listed below:

#### Lot 2 specific service requirements:

SATCOM service bandwidth	The SATCOM service bandwidth shall allow to transmit up to four <b>MPEG2TS stream</b> (EO, IR, SAR and radar sensors, etc.), Command and Control link and metadata information	Mandatory
SATCOM service effective data rate	<p>The minimum data rate of the return link shall be <b>≥5Mbps</b></p> <p>The minimum data rate of the forward link shall be enough to transmit the Command and Control link and the payload data link shall transmit in parallel <u>up to four sensor streams</u> with the below mentioned resolution:</p> <ul style="list-style-type: none"><li>• compressed video stream with a video resolution of <b>720x576, 1024x768 or 1920 x 1025 @10fps</b> (this fps value is indicative)</li><li>• IR sensor stream with at least <b>700 pixels</b> in one dimension</li><li>• Maritime radar sensor data</li><li>• SAR sensor data</li><li>• in parallel to the video stream with the above mentioned resolution the system shall be able to transmit an <b>image</b> with a resolution of at least <b>2 megapixel every second</b></li><li>• all flight, <b>housekeeping</b> and <b>metadata</b> needed to fully characterize the data received (e.g. georeferenciation)</li></ul>	Mandatory

## 2.4 SATCOM terminal requirements

- 2.4.1 For Lot 1,2 the Contractor shall make available a list of compatible SATCOM terminals and provide the corresponding performance (link budget) of the offered SATCOM solution when using each one of the terminals.
- 2.4.2 It is not compulsory but it is recommended to place at the disposal of the Agency's RPAS Services Providers leasing contracts for the SATCOM terminal within the list of compatible terminals in order to minimize the implementation risk. In the instance of including the terminal leasing option the Contractor must provide the expected leasing prices for the offered SATCOM terminal.
- 2.4.3 If the leasing option is not envisaged the list of compatible terminals should only include off-the-shelf SATCOM terminals. In the case of including the leasing option, customized SATCOM terminals can be incorporated.

### SATCOM terminal general requirements:

Antenna type	Phased array antenna solutions, planar antennas, etc.	Advantage
Polarization	Circular	Advantage
Antenna pointing error	<b>&lt; 0.2°</b>	Mandatory
Multi-frequency terminals	Multifrequency terminals are not mandatory but are preferred	Advantage
Sidelobe level	<b>&lt;15dB</b>	Mandatory
Antenna radome losses	<b>&lt; 1dB</b>	Advantage

- 2.4.4 EMSA current RPAS with BRLOS communication capabilities are medium size RPAS but the Agency has launched a new procurement for large size RPAS (EMSA/OP1/2018). The maximum weight and size of the SATCOM terminal that could be fitted to each type of RPAS is listed in the tables below.
- 2.4.5 Suitable terminals for both types of RPAS can be included in the list; however the terminal restrictions in terms of weight and size for each type of RPAS must be respected.

**SATCOM terminal requirements for medium size RPAS:**

Maximum weight	Antenna weight <b>&lt;5kg</b> , terminal weight (including ACU and modem) <b>&lt;15kg</b>	Mandatory
Antenna equivalent diameter	Equivalent diameter <b>&lt;0.3m</b>	Mandatory

**SATCOM terminal requirements for large size RPAS:**

Maximum weight	Antenna weight <b>&lt;15kg</b> , terminal weight (including ACU and modem) <b>35kg</b>	Mandatory
Antenna equivalent diameter	Equivalent diameter <b>&lt;0.45m</b>	Mandatory

## 2.5 Lot 3: Satellite internet service

2.5.1 The general requirements applicable to Lot 3 are listed below:

### Satellite internet service requirements:

Internet connection speed	The effective throughput (upstream and downstream) shall be <b>&gt;10Mbps</b>	Mandatory
Latency	The point-to-point latency from the RPAS to the CGCS/RPAS-DC shall be <b>&lt;2s</b>	Mandatory
Supported links	RLOS and BRLOS: <ul style="list-style-type: none"><li>• Payload data link, housekeeping and metadata information</li><li>• Command and Control link (primary and backup)</li></ul>	Mandatory
VSAT and communication equipment	Provision of the VSAT and all necessary communication equipment (modem, switches, hub, etc.)  Network configuration (router, host, server, port, etc.)  Software needed for network configuration	Mandatory
VSAT and communication equipment	The VSAT and all the communication equipment must be portable and suitable to be used on the ground or to be embarked on a ship for VTOL (Vertical Take-off and Landing) RPAS operations.	Mandatory
Protocols	The complete stack of internet protocols shall be supported and no port shall be restricted	Mandatory

### **3 Project management**

- 3.1.1 Project management must be established over the entire Framework Contract (FWC) to ensure the coordination of the project team, the financial and contractual monitoring and the technical coherence of the project tasks.
- 3.1.2 The Contractor shall ensure that responsibility and project documentation requirements are met throughout the contract.

#### **3.2 Responsibility requirements**

- 3.2.1 The management necessary for completion of all tasks under this contract shall be the responsibility of the Contractor. This includes the management of subcontractors as well as the control of the Contractor's own resources.
- 3.2.2 The Contractor shall provide complete visibility to the Contracting Authority of all aspects of the work.
- 3.2.3 The Contractor shall have the full responsibility for equipment procurement from subcontractors and suppliers. This will include ordering, monitoring of progress as required, as well as technical management tasks.
- 3.2.4 The Contractor shall impose on each subcontractor, requirements for management, visibility and control that, as a minimum, are equivalent to the requirements imposed on the Contractor. Technical documents from subcontractors shall be submitted to the Contracting Authority only after review and acceptance by the Contractor.

#### **3.3 Project documentation requirements**

- 3.3.1 All documents and mail exchanges between the Contracting Authority and the Contractor shall be written in English.
- 3.3.2 The Contractor shall submit all documents to the Contracting Authority in searchable PDF format as well as in their native format (e.g. word), either by email, ftp or using CDROMs.
- 3.3.3 A preliminary Project Management Plan (PMP) shall be part of the proposal. The PMP will be updated for the KOM and when necessary it shall contain the description of the Contractor's project team organisation, the hierarchy, the key members, the subcontractors and suppliers, etc.
- 3.3.4 An action item list document shall be provided as a separate document. It shall contain all actions listed throughout meetings and shall be revised and re-issued.
- 3.3.5 For each SC the Contractor shall provide the Contracting Authority with a monthly service report covering the services provided and the activities covered under the specific contract. The report should include among other the information on data volume consumption, data rate, system configuration, as well as QoS information.
- 3.3.6 For each SC the Contractor shall provide the Contracting Authority with quarterly invoices services of the services and the activities covered under the SC.



### **3.4 Schedule**

- 3.4.1 The Contractor shall establish a schedule that is consistent with the planned start of work and the milestones. Any deviation shall be identified and duly justified. This schedule shall be part of the PMP.
- 3.4.2 When a change in the planning has taken place, a concise description of the change, its cause and effects, remedial actions taken (if necessary) etc. shall be provided. Contractual milestones cannot be changed without prior approval by the Contracting Authority.
- 3.4.3 Contractor shall present an up-to-date schedule for review at all meetings, indicating the current status of the contract activity (tasks completed, documents delivered, etc.)
- 3.4.4 Progress meetings between the Contractor and the Contracting Authority shall take place (either at the Contractor's premises, either at Contracting Authority, or using tele/video-conference).
- 3.4.5 The overall duration of the service provision shall be two years plus the possible renewal for one year and additional renewal for another year.

### **4 Quality assurance**

- 4.1.1 Quality assurance requirements must be ensured over the entire FWC duration. The Contractor shall ensure that quality requirements are met throughout the project.
- 4.1.2 The Contractor shall address at least the following processes:
  - requirements management
  - system and service quality assurance
  - configuration management
  - problems and non-conformance management
  - verification and validation
  - subcontractor(s) selection and control
  - competence of personnel
  - documentation management
- 4.1.3 The Contractor shall be responsible for the quality of the deliverables; however Contracting Authority reserves the right to request technical visibility.
- 4.1.4 The Contractor shall maintain quality records to provide objective evidence of complete and effective performance of quality assurance activities and to demonstrate the achievement of the required quality. The Contracting Authority shall have the right to access quality records upon request.

## **5 On-ground compliance test (before signature of the FWC)**

For Lot 1,2:

- 5.1.1 Before the signature of the FWC an on-ground compliance test will be required. This test shall ensure that only mature SATCOM solutions, already fulfilling the minimum requirements, will be selected for the FWC.
- 5.1.2 The on-ground compliance test can take place at the Bidder's premises or at any location chosen by the Bidder.
- 5.1.3 The SATCOM terminal to be used for the on-ground compliance test shall be one of the terminals included within the list of compatible terminals.
- 5.1.4 The main objective of the on-ground compliance test is to check that the following elements of the proposal are met:
  - verification of the end-to-end SATCOM link: between the SATCOM terminal and the Satellite Service Provider's server
  - latency requirements, as per section 2.1
  - Command and Control link transmission
  - Payload data link transmission<sup>2</sup>:
    - Lot 1: one sensor data stream must be transmitted at the data rate specified in 2.2
    - Lot 2: at least two sensor data streams must be transmitted at the data rate specified in 2.3
- 5.1.5 Before the initial on-ground compliance test, the following documents have to be provided by the Contractor:
  - on-ground compliance test plan
  - on-ground compliance test procedures description

## **6 In-flight test (first service set-up)**

For Lot 1,2:

- 6.1.1 During the very first service set-up an in-flight test shall be held with the presence of representatives of the Contracting Authority in order to assess and document if the capabilities as offered and requested in the contract are available.

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<sup>2</sup> *The Agency might provide raw sensor data recorded on-board of the Agency's RPAS to test the transmission of the sensor data streams*

- 6.1.2 The in-flight test shall take place at the RPAS Services Provider's facilities or at the site selected for the RPAS operations
- 6.1.3 The in-flight test must be performed with the SATCOM terminal and the system configuration intended to be used during the execution of the SC.
- 6.1.4 The in-flight test will be concluded with an evaluation of the operational service capabilities against the requirements of sections 2.2, 2.3 and 2.4.
- 6.1.5 Before the in-flight test, the following documents have to be provided by the Contractor:
- In-flight test plan
  - In-flight procedures description

For Lot 3:

- 6.1.6 During the very first service set-up an internet connection test shall be held in order to assess and document if the capabilities as offered and requested in the contract are available.
- 6.1.7 The test shall take place at the site selected for the RPAS operations
- 6.1.8 Before the test, the following documents have to be provided by the Contractor:
- internet connection test plan
  - internet connection test procedures description

## **7 Operational briefing (in situ for each SC)**

For Lot 1,2:

- 7.1.1 At the end of each set-up, before the start of module\_02, an operational briefing shall take place at the site selected for the RPAS operations to guarantee the satellite coverage over the operations area and to verify the performance of the SATCOM solution as obtained in the in-flight test (section 6).

For Lot 3:

- 7.1.2 At the end of each set-up, before the start of module\_02, an operational briefing shall take place at the site selected for the RPAS operations to guarantee the satellite coverage over the operations area and to verify the performance of the satellite internet solution as obtained in the internet connection test (section 6).