Leeds-Bradford
Romeo5 Ground proposal

Leeds Bradford®
Yorkshire's Airport

DataBeacon

ROMEO5 Ground

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1 EGNM Purpose of this document and our understanding of the operational context

This document describes the provision of a robust ATM-grade Flight Information Display System for Air Traffic Services Ground Situational Awareness called Romeo5 Ground or simply R5 Ground.

Leeds Bradford Airport is faced with unique challenges related to low visibility, predominantly influenced by its altitude, resulting in frequent activation of Low Visibility Procedures (LVPs) and subsequent delays. In response to this issue, our proposal presents R5 Ground, an advanced Flight Information Display (FID) system specifically designed to enhance situational awareness for Air Traffic Control Officers (ATCOs) operating within the ground movement area. R5 Ground offers a cost-effective solution to improve safety and efficiency, particularly during LVPs, by utilizing ADS-B surveillance data as its primary input. The comprehensive turn-key system includes the installation of ADS-B antennas and receivers strategically positioned to optimize coverage and enhance data transmission for R5 Ground. Our system has the capability to integrate data from multiple ADS-B receivers, therefore, potentially increasing the number of receivers in the future is essential to ensure full coverage of the ground movement area.

R5 Ground delivers a comprehensive surveillance picture of the ground environment, specifically focusing on the movement area. Given that Leeds Bradford Airport already possesses radar capabilities for airborne traffic, our system aims to complement this by providing detailed ground-level information using ADS-B, mitigating the challenges posed by low visibility conditions. The same technology stack, software architecture, and user interface have been used to build and deploy our FID in several airports in the UK, which underscores its effectiveness in addressing operational challenges and contributing to a more streamlined air traffic management process.

Furthermore, the adherence of our system to UK regulations ensures that Leeds Bradford Airport will be well-equipped to meet any future requirements set forth by regulatory authorities. By leveraging our proven technology and expertise, the airport can confidently navigate evolving regulatory landscapes and maintain operational efficiency in the face of changing demands.

Various aviation authorities worldwide are currently overseeing and authorising the implementation of ADS-B technology for ground situational awareness. For instance, the FAA has granted approval for a very simplified version of these systems, while Europe is developing a more comprehensive specification through the SMAS (Surface Movement Awareness System) task force under the leadership of Eurocontrol, with DataBeacon as a member of such task force. Although the UK Civil Aviation Authority (CAA) does not currently have a specific specification for such systems, it has played a key role in regulating and approving the use of ADS-B for Flight Information Displays (FID) for AFIS. This suggests that ground situational monitoring will likely be subject to regulation and approval in the future.

Romeo5 Ground has been meticulously designed to align with the specifications outlined in CAP670 for Flight Information Displays by the CAA, ensuring seamless compliance with future CAA regulations for ground monitoring. It is important to note that the CAA requires an on-premise software solution for processing data locally, rather than cloud processing. This indicates that cloud systems may not be approved by the CAA for surveillance monitoring purposes in the short term.

1.1 Scope of this proposal

This proposal showcases an exciting technical advancement for a candidate system to be ready to be implemented for operational use. The technical candidate will thrive in a regulatory environment that embraces the use of ADS-B technology as a powerful situational awareness tool on the ground, which is currently not available in the UK. The utilisation of ADS-B as a situational awareness technology within the CAP670 regulation has paved the way for the deployment of Flight Information Displays to enhance both information services and air traffic control services in areas where radar coverage is lacking. While there are no guarantees that the same regulation can be applied to airport platforms or that similar regulations will be developed for airport surfaces, the potential for growth and innovation in this area is promising. The document describes a multi-phase approach to allow the customer to work with the regulator ensuring the approvals needed for its operation and emphasises the technical development of the system and their regulatory approval. While we are dedicated to support any

technical requirements that may arise, it is important to note that regulatory work needs to be conducted in parallel for this initiative to be successful.

The primary focus of this proposal is the deployment of R5 Ground situational awareness. It is important to acknowledge that the system holds potential for future enhancements and product evolution, some of which may necessitate specific regulatory approval. This potential for future evolution is enabled by a meticulously planned data engineering technical roadmap that facilitates efficient real-time and batch data processing. In addition to the current development and functionalities, gradual integration of features such as geo-fencing to prevent runway incursions will ensure a future-ready solution. A comprehensive dashboarding solution has also been devised to ensure the utility of the collected data for optimizing platform and runway usage. Some of this additional functionalities are also described in this proposal.

Optional supportive regulatory work provided by DZ Aviation Consultancy has been included within this proposal, however given the unknown regulatory aspects that may be applied by the UK Civil Aviation Authority in relation to use of a FID for ground surveillance, no assurances or guarantees of a successful approval are provided.

2 EGNM About Us

2.1 DataBeacon

DataBeacon is a leading software company specializing in aviation tools. Our team comprises highly skilled data scientists, data engineers, and aeronautical engineers, along with operational experts who bring their expertise in data-driven services to the aviation industry. With a deep understanding of aircraft, airport, and airspace data, our team has accumulated industry-recognized experience.

We have developed aviation software that supports operations with reliability, scalability, and maintainability as the cornerstones of our technology. Leveraging cutting-edge advancements in technology, our aviation software is designed to support air traffic control operations and can be deployed both on-premises and in the cloud. We pride ourselves on our ability to develop innovative solutions that meet the evolving needs of the aviation sector. With our deep expertise in data-driven services, coupled with our experience in aircraft, airport, and airspace data, we are well-equipped to provide comprehensive solutions for aviation operations.

DataBeacon's mission is to unlock the full potential of data-driven services in aviation. DataBeacon supports operations with its cutting-edge technology, industry expertise, and unwavering commitment to innovation, reliability, scalability, and maintainability.

DataBeacon has experience with various aviation datasets and data formats including ADS-B/C, FMS (ARINC 717/573), A-SMGCS (multilat. radar), Radar (ASTERIX), SWIM (ADEXP v3.3), DDR2 (OPLOG, Regulations, Sectorisation/TFVs), METAR, SIGMET, SNOWTAM, runway wind profiles, and NOTAM.

DataBeacon has developed several products powered by surveillance data based on Victor5, a powerful cloud computing platform and versatile front-end receiving real-time surveillance data feeds and displaying the information provided by algorithms running real time in a flexible on-premise or on a cloud infrastructure. With a similar look and feel of an ATC console, developed by front-end experts using modern software technologies and validated with air traffic controllers and human factor experts from several ANSPs.

Based on the Victor5 platform, DataBeacon developed SimpliFID, a Flight Information Display following the UK CAP670 regulations. SimpliFID is a low-complexity Flight Information Display (FID) unit for aerodromes and airports compliant with CAP670. SimpliFID is a highly accessible and cost-effective alternative to a traditional radar and surveillance data processing system. Utilising multiple data sources, including ADS-B, it offers a user-friendly interface providing increased visibility to AFISOs and ATCOs.

Utilizing cutting-edge technologies, DataBeacon has developed Romeo5, an enhanced version of the Flight Information Display system. This product builds upon the previous version by introducing several new functionalities to the existing technology:

- Implementation of simultaneous on-premise and cloud instances, offering flexibility while ensuring compliance with local data processing regulations.
- Inclusion of a 30-day video recording feature in on-premise installations, allowing for potential investigations or incident reviews.
- Unlimited cloud data recording and an online replay tool, enabling users to access and replay all received data at varying speeds for post-operational safety analysis or training purposes.
- Introduction of a new user-friendly front-end with features such as selectable traffic speed vectors, geographical location names, and other enhancements.
- Integration of a new data tracker that consolidates data from multiple antennas and automatically selects the highest quality data, with visual notifications for potential ADS-B target dropouts.
- Provision of integrated air and ground support for airport operations.
- Capability for multiple clients to run simultaneously.

2.2 DZ Aviation

DZ Aviation is an aviation consultancy and support service provided by Nick Duriez. Nick is a former Airport Manager at Manchester Barton with 25 years of experience across aerodrome and ANSP licencing, and aerodrome business management. A former AFISO and validity examiner, Nick was involved in the FID trials from 2019-2022 the culmination of which regulated in the CAA publishing the CAP670 regulations that permit FID's within both AFIS and ATC environments. Nick also led and obtained the first ANSP (AFIS) FID approval under these requirements.

Nick now works closely with DataBeacon, both in promoting sales leads within the UK, and provision of additional operational, technical and regulatory support to assist in the deployment and continued development of Romeo5.

3 EGNM Romeo5 Ground functional description and user interface

Romeo5 Ground is a system providing Surveillance Service of ADS-B equipped aircraft and ground vehicles to maintain the airport throughput under all local weather conditions and an acceptable level of safety. While this system does not provide the same safety assurance level as A-SMGCS due to the lack of detection of non-cooperative mobiles (i.e. non-equipped ADS-B traffic and vehicles), it does not require costly surface radar equipment. Romeo5 is designed to improve ATCOs' or AFISOs' situational awareness and serve as a tactical tool.

Romeo5 Ground is presented as an on-premise software, with direct connectivity to the ADS-B receivers.

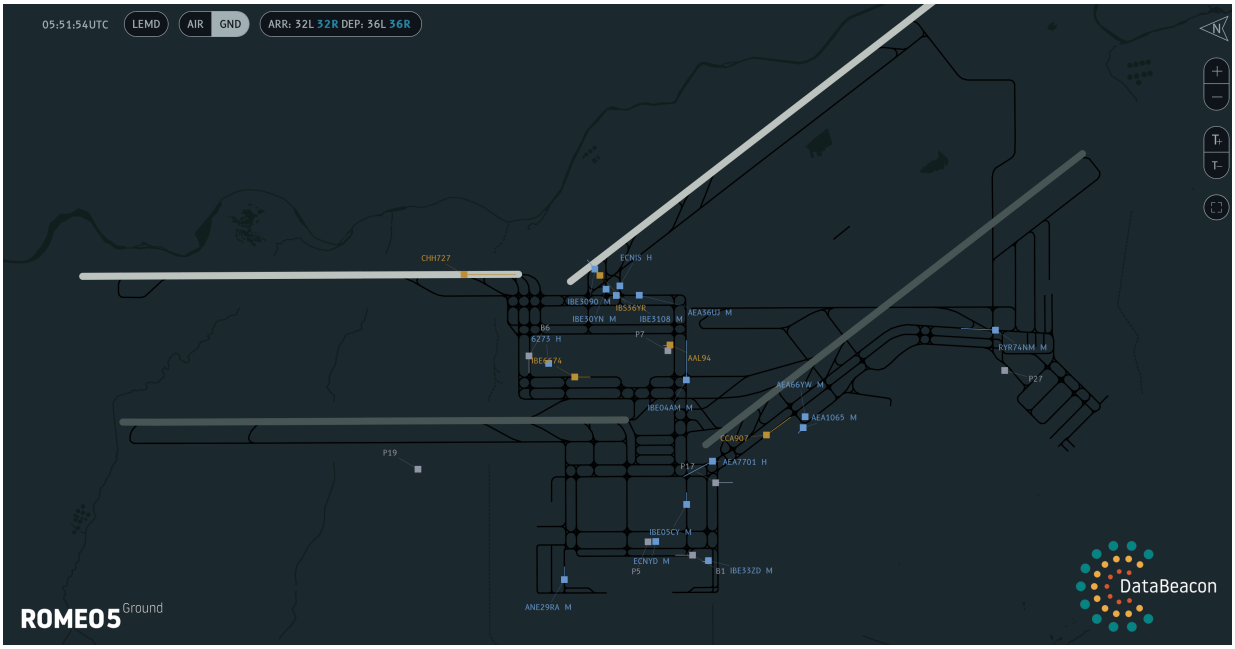

Figure 1 Figure X - Romeo5 showing LEMD ground operations, as seen in a 27" monitor, showing alerts of runway in use.

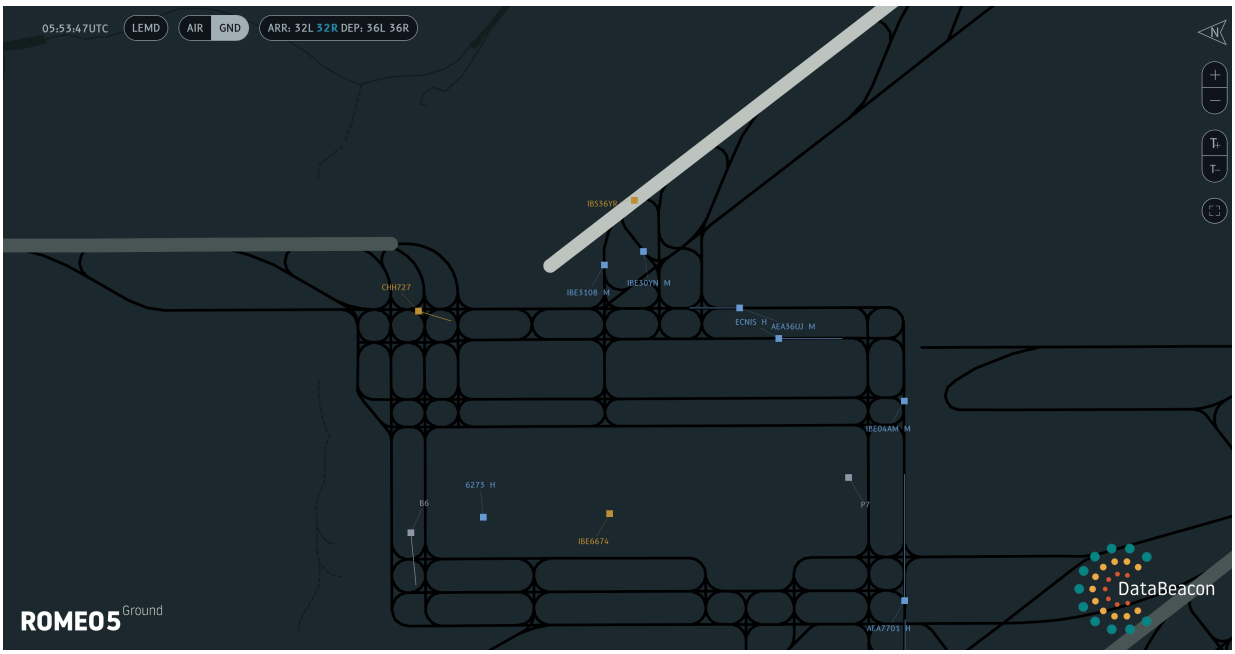

Figure 2 Figure X - Romeo5 showing LEMD zoomed-in ground operations, as seen in a 27" monitor, showing alerts of runway in use.

Romeo5 presents several services integrated in a **software product that runs on-premise**, as required for most regulators, like the UK CAA. Romeo5 services can optionally run **simultaneously in the cloud** offering additional redundancy and use cases. Romeo5 services are:

- Surveillance Services
- Recording services
- Analytics and dashboard services
- Alerting services

The **Surveillance Service** offered by Romeo5 is the fundamental component that serves as the foundation for our suite of services. This service provides essential airport traffic situational awareness by displaying identification, position, and tracking of cooperative mobiles on a user-friendly HMI (front-end). In order to achieve positive identification of targets, at least one cooperative sensor in each vehicle or aircraft is required. The Surveillance Service encompasses aircraft on approach within the coverage volume, allowing Controllers to utilise Romeo5 to assist in controlling inbound aircraft and seamlessly integrating arrivals with departures or mobiles crossing active runways. Romeo5 offers real-time information on ground traffic using terrestrial ADS-B data feeds from antennae/receivers strategically placed at the airport or its vicinity, ensuring line of sight over the airport platform. Where multiple antennas are present, the system allows for seamless antenna selection, providing flexibility and control over the data sources used for enhanced precision.

Our system provides continuous updates on the position of aircraft or vehicles, refreshing approximately every second without lag or processing delays. In instances where multiple antennas are deployed for coverage optimization or redundancy, our system excels in merging data from these sources to display the most recent position available from any receiver, thereby enhancing the accuracy of ground traffic monitoring. The design, implementation and maintenance of the Romeo5 must take into account the aerodrome environment and operational procedures in order to minimise radio interference and radio reflections. Changes to structures, environment or procedures can cause significant degradation on the performance of the Surveillance Service and need to be carefully considered.

Romeo5 front-end provides a synthetic representation of the aerodrome traffic situation within the coverage volume based on the Aerodrome Environment, the position of all cooperative mobiles on the movement area, identity of all cooperative mobiles on the movement area. The goal is to provide benefits to the air traffic controllers by providing the position and the identity of all cooperative mobiles, within the coverage volume independent of visibility conditions and Controller line of sight. The system also prioritizes contrast for optimal visibility, ensuring that displayed information remains clear and discernible in various ambient lighting conditions.

Our front-end is equipped with target classification capabilities to enhance the clarity of situational awareness. The system distinguishes landing aircraft, departing aircraft, and other ground vehicles, assigning distinct colors to each category for quick identification. For departing aircraft, the system incorporates the wake vortex category, if available from the ADS-B message, facilitating visibility on the optimized departure sequence due to wake turbulence separation. To further refine the understanding of ground traffic dynamics, Romeo5 includes a speed vector for each aircraft. This vector enables users to ascertain the order of approaching aircraft at intersections and facilitate the give-way instructions.

Romeo5 adheres rigorously to the regulatory standards outlined in UK CAA CAP670 for Flight Information Displays (FIDs), ensuring compliance and reliability in air traffic management. The system incorporates a range of intuitive control elements, aligning with best practices in the industry and reviews from human factor experts. Users have the capability to zoom the map and labels independently, providing a customizable display that caters to specific operational requirements.

The mapping functionality is designed to align with the standards set forth in UK regulations, ensuring accuracy and compliance in displaying critical flight information. Customers are afforded a high degree of customization at design stage, empowering them to tailor the map orientation to either the North or align it with the perspective as seen from the tower window. This adaptability during the design caters to individual customer preferences, providing a client-centric interface for enhanced operational efficiency and meeting regulatory approvals.

The system offers comprehensive customization options, enabling clients to personalize maps during design by incorporating essential details such as gate names, taxiway labels, and other pertinent ground features. This level of customization fosters a tailored user experience, streamlining the identification and tracking of specific locations within the airport environment.

Romeo5 Ground further enhances its versatility with the integration of customizable layers. Users can selectively activate or deactivate layers to display different elements, including but not limited to taxiway names, stand numbers, or information related to Low Visibility Procedures (LVP). This layering capability ensures that the displayed information is contextually relevant and aligns precisely with the operational needs of the users.

Romeo5 Surveillance Service will **allow the users**:

1. to confirm the identity of all participating mobiles according to the defined identification procedures.
2. to anticipate situations that can result in collisions between all cooperative aircraft and cooperative aircraft and cooperative vehicles, especially in conditions when visual contact cannot be maintained.
3. to detect and indicate the position of potential cooperative intruders.

Romeo5 offers **recording services** to ensure post-safety analysis review and investigations of any potential event. Concretely, two optional recording services are offered to provide a comprehensive ability to evaluate past operational scenarios:

1. Video recording: every Romeo5 unit records 30-days of video that can be accessed directly in the unit or through a local area network. This video recording is the same as it was display in the monitor of every unit.
2. Data recording: Surveillance data is submitted for cloud storage and used through an online replay tool that allows to reproduce any past scenario. The online replay tool runs on the cloud so it can be accessed from any location by any authorized user. The interface allows to replay scenarios at different reproduction speeds, access the data from previous operations and load it to the interface instantly and measure distances between any traffic, among other features.

Furthermore, Romeo5 offers a range of analytics and dashboard services designed to enhance operational efficiency in a cloud-based environment. These services include real-time operational information and historical analytics:

1. **Real-time Operational Table**: Romeo5's real-time operational table utilizes ADS-B data to automatically monitor aircraft movements, providing a detailed log of arrivals and departures at the airport. This feature captures essential information such as aircraft locations, runway utilization, entry and exit times, turnaround processes, and integration with airport fee systems. In addition, Romeo5 tracks supplementary data such as exit taxiway usage, paths to the stand, pushback duration, and taxi times to the holding point.
2. **Dashboarding and Analytics**: Leveraging the data collected, Romeo5 generates customized insights for various airport stakeholders. For airport infrastructure management, it offers analysis on taxiway and runway utilization. In the realm of Collaborative Decision Making (CDM) and Air Traffic Management (ATM), Romeo5 tracks key time metrics including landing and departing runway occupancy time, as well as taxi and pushback times. Moreover, tailored dashboards are provided for Air Traffic Control (ATC), focusing on safety insights such as average aircraft speeds and abrupt braking events.

Thu, 17 Oct 2024 05:27:19 UTC — LEMD OPEX — Include ground hold flights — Show open flights only

WTC	Arrival Callsign	Arrival Landing UTC	Arrival RWY	Stand	Departure Callsign	Departure Take-off UTC	Departure RWY	Turnaround
M	IBE31RW	2024-10-16 21:22:22	18L	340	IBE05CY			
H	AEA042	2024-10-17 02:12:34	18L	T19	AEA1091	2024-10-17 05:26:21	14L	3h 13m 47s
M	ANE29QD	2024-10-16 20:39:42	18R	320	ANE29RA			
M	ANE14EM	2024-10-16 17:57:23	18R	411	ANE35XG			
M	ANE8853	2024-10-17 05:25:46	18L					
M	AEA45KB	2024-10-16 19:44:45	18L	20	AEA60GX			
M	AEA84XW	2024-10-16 19:12:57	18R	T32	AEA9059	2024-10-17 05:24:04	14L	10h 11m 7s
M	ANE8959	2024-10-17 05:23:54	18R					
M	IBS37QZ	2024-10-16 21:35:55	18L	356	IBS3918	2024-10-17 05:22:36	14L	7h 46m 40s
M	IBS3729	2024-10-16 21:08:20	18L	364	IBS3826	2024-10-17 05:21:23	14L	8h 13m 3s
M	IBS3849	2024-10-16 22:48:49	18L	338	IBS3844	2024-10-17 05:20:01	14L	6h 31m 12s
H	BCS41E	2024-10-17 03:50:52	18L	213	BCS220P			
M	AEA4050	2024-10-16 20:02:19	18R	21	AEA4047	2024-10-17 05:18:42	14L	9h 16m 23s
M	ANE83KQ	2024-10-16 21:20:25	18R	324	ANE27NP			
M	AEA72QN	2024-10-16 18:41:18	18L	T32	AEA1515	2024-10-17 05:17:21	14L	10h 36m 3s
M	RYR846T	2024-10-17 00:03:44	18L		RYR61FR	2024-10-17 05:15:57	14L	5h 12m 13s
M	IBS3811	2024-10-16 20:51:18	18L	336	IBS3866			
M	DLH04A	2024-10-16 19:56:46	18R	T28	DLH55A			
M	THY2GQ	2024-10-16 20:20:45	18L	31	THY1RU	2024-10-17 05:14:45	14L	8h 53m 59s
M	ANE27TM	2024-10-17 05:12:37	18L					
M	AEA1142	2024-10-16 20:19:17	18R	T18	AEA9156			
0	RYR2085	2024-10-16 20:13:20	18L	32	RYR2085			

Figure 3 Figure X - Example of real time operational table

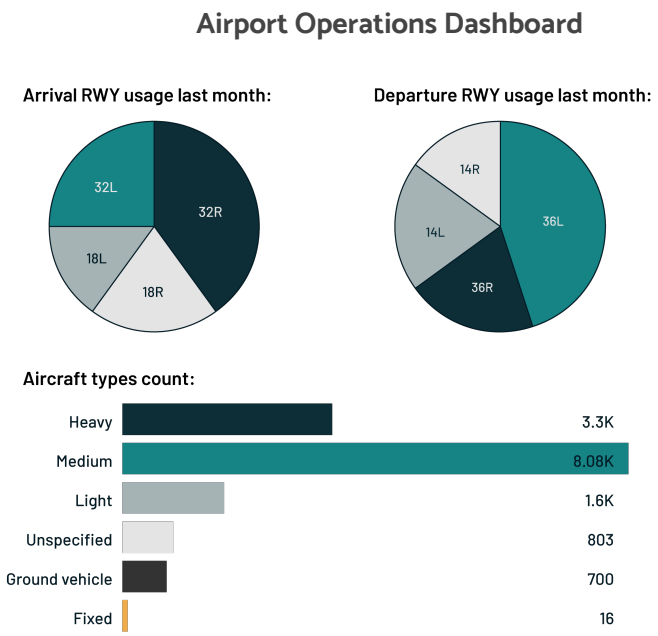

Figure 4 Figure X - Example of Romeo5 dashboarding services

Additionally, Romeo5 offers a range of advanced **alerting services** designed to enhance situational awareness and improve safety measures within airport operations. These services enable real-time computations on the positions of various traffic and vehicles, allowing for the display of alerts to users. Alerts can include, for instance, detection of active runways, aircraft in close proximity to runways, stationary vehicles or traffic, aircraft aligned or lined up with inactive runways, and information on runway suitability for specific aircraft types.

While some alerts are already integrated into Romeo5, the platform has the capability to accommodate additional alerts as needed and integrate those in the user interface to ensure maximum visibility and awareness by the user. The design and implementation of these alerts require collaboration between the users from the local Air Navigation Service Provider (ANSP), airport operators, and regulators to ensure alignment with operational procedures and safety standards. Inputting additional information, such as runway status, may be necessary for certain alerts to function effectively.

Overall, Romeo5's alerting services offer a customisable solution to enhance safety and efficiency in airport operations, with the flexibility to adapt to specific operational requirements through collaboration and discussion with relevant stakeholders.

4 EGNM Multi-Phase Implementation Strategy

This proposal outlines a comprehensive multi-phase implementation strategy for the advancement and deployment of the candidate system. The strategy is designed to progress through five key phases: Candidate system development, Installation at the controllers working position "not for operational use", Trial with CAA approval, and Changes and adaptations from trial. Each phase will be carefully executed to ensure the successful integration and utilization of the system in a regulatory environment that embraces ADS-B technology.

The following five phases are presented:

- Proof of Concept Phase
- System Development Phase
- Installation and Testing Phase
- Trial and Approval Phase
- Adaptation and Refinement Phase
- Regulatory approval process

4.1 Phase 0 - Proof of Concept

The purpose of this phase is to establish a framework for cooperation between the parties to conduct a **Proof of Concept (POC)** for **Romeo5 Ground**. This POC aims to demonstrate the feasibility of using **Romeo5** for ground-based situational awareness at Leeds Bradford Airport, with the possibility of introducing the concept to the UK Civil Aviation Authority (CAA) for future regulatory consideration.

Phase 0 also aims to test the current technology developed by DataBeacon for potential use in ground surveillance at Leeds Bradford Airport and to gather information about requirements related to data processing, coverage, usability, alerts, and other general operational needs. It is not the purpose of this Phase 0 to use the system operationally in any capacity, not even as a general trial.

The scope of the POC is as follows:

- **Installation and Configuration**:
    - DataBeacon will provide and loan a single pre-configured ADS-B antenna for the trial period.
    - Leeds Bradford Airport will install the antenna at a suitable location with significant visibility over the airport platform and configure it to the required network/internet settings with support from DataBeacon.
    - DataBeacon will receive data from the antenna and incorporate it into a cloud-based **Romeo5** display, accessible via a browser.
    - The display will provide a basic ground layout of the airport with no specific customizations at this stage.
- **Evaluation**:
    - Leeds Bradford Airport will evaluate the performance and functionality of Romeo5 for potential operational use.
    - Leeds Bradford Airport will introduce the POC to the CAA with the objective of gaining regulatory interest and support for potential future trials for ground-based ADS-B situational awareness.
- **Feedback and Issue Resolution**:
    - Leeds Bradford Airport will provide feedback to DataBeacon on any issues or improvements during the POC, enabling DataBeacon to make any necessary adjustments.

4.1.1 Roles and Responsibilities

- **DataBeacon:**
  - Provide a pre-configured ADS-B antenna for the duration of the POC.
  - Offer remote technical support for the installation and network setup of the antenna.
  - Operate and maintain the cloud-based Romeo5 display for the duration of the POC.
  - Collaborate on any regulatory discussions or technical evaluations involving the CAA.
- **Leeds Bradford Airport**:
  - Install the ADS-B antenna in a suitable location and configure it for network access.
  - Evaluate the Romeo5 software for ground-based situational awareness and provide feedback.
  - Engage with the CAA regarding the potential regulatory implications of the trial.
  - Share insights and results from the POC with DataBeacon for potential further developments.

4.2 Phase 1 - System Development Phase

The primary objective of this phase is to develop a system that meets the criteria to be considered as a candidate for installation and testing within the Visual Control Room (VCR) environment. The system will be meticulously designed to incorporate all specified features outlined by the customer, with a particular focus on layout, mapping configuration, visual reference points, and other essential elements. Adherence to the principles outlined in CAP670 will be paramount in ensuring the system's design aligns with the necessary visual and performance requirements. To achieve comprehensive coverage of the surface area, the installation of multiple ADS-B antennas will be essential.

Before the development of this candidate system start, a series of collaborative online sessions with the customer will be organised, with the goal of collecting requirements. Design, development and testing will follow. The system will be deployed locally within the airport premises, albeit not within the Visual Control Room, allowing the customer to engage with stakeholders, including end-users and regulatory bodies. Concurrently, safety assurance and the initiation of the regulatory case will be integral components of tis phase.

The establishment of a candidate system will facilitate the testing, validation, and assessment of the system's utility, coverage, reliability, and the identification of any unforeseen requirements that may arise before the system is fully operational. Given that the system will not be installed in the VCR during this phase, regulatory compliance requirements are not applicable.

The outcome of this phase of the project will be a set of requirements that can be tracked, implemented and tested and the development of a candidate system that meets the requirements outlined by the customer . After installation and testing in a non-operational environment the goal is to qualify the system for installation within the Visual Control Room (VCR) environment. The system will be meticulously designed to incorporate all specified features, with a focus on usability, including layout, mapping configuration, visual reference points, and other essential elements.

During this phase, a first ADS-B antenna and receiver will be installed to achieve comprehensive coverage of the surface area to be tested.

After development, the candidate system will undergo collaborative online sessions with the customer to gather requirements, followed by rigorous design and testing phases. The system will be deployed locally within the airport premises for stakeholder engagement, including end-users and regulatory bodies. Safety assurance and the initiation of the regulatory case should also be integral components of this phase (notice safety assurance work is not included in this proposal).

The establishment of the candidate system will allow for testing, validation, and assessment of its utility, coverage, reliability, and identification of any unforeseen requirements before full operational deployment. Some regulatory compliance requirements will not be applicable during this phase as the system will not be installed in the VCR, but those need to be identified for the following phase.

Surveillance hardware for redundancy and to successfully meet coverage requirements requires coverage redundancy requirements and coverage analysis to define the right number and location of antennas and

receivers. No specific number of such is provided in the proposal, and our team is committed to working closely with the customer to support the analysis and facilitate communication with the chosen ADS-B antenna/receiver manufacturer. Therefore, please note that the budget does not include provisions for this aspect.

To provide adequate timescales, coincident with system development the preparation of a GEN03 Trial submission will be undertaken to seek approval and endorsement for the proposed trial from the CAA.

4.3 Phase 2 - Testing phase

Phase 2 marks a pivotal stage in the implementation process, focusing on the installation and testing of the Romeo5 Ground system within the Visual Control Room (VCR), contingent upon the successful approval of Phase 1. The primary objective of this phase is to introduce the system into the VCR environment, albeit with a watermark denoting it as "not for operational use." This designation serves the purpose of allowing operational staff to observe the system in action, facilitating direct comparisons with the traditional window view, and enabling personnel to provide valuable feedback regarding system requirements and potential modifications.

The installation of the Romeo5 Ground system in the VCR will provide operational teams with the opportunity to assess its functionality, usability, and effectiveness in enhancing situational awareness within the control room. By actively engaging operational staff in the observation and evaluation process, valuable insights can be gleaned to inform any necessary refinements or enhancements to the system.

Furthermore, it is important to note that the potential need for approval from the Civil Aviation Authority (CAA) may arise during this phase, underscoring the critical importance of compliance with regulatory standards and ensuring the safe and efficient operation of the system within the VCR environment. Adherence to regulatory protocols and guidelines will be paramount throughout the installation and testing phase to uphold the highest standards of safety and operational excellence.

During this phase the data infrastructure will allow acquisition, validation and representativeness assessment of the airport operations through an automated procedure in an operational fault-tolerant environment. Privacy, confidentiality and security methodologies will be implemented to guarantee data security. All the functionalities will be deployed in an operational fault-tolerant environment with alerts in case of system failure. Algorithm robustness and stability will be assessed and ensured.

Overall, Phase 2 represents a crucial step towards the comprehensive evaluation and validation of the Romeo5 Ground system within the VCR setting, laying the foundation for further refinement and optimization based on feedback from operational stakeholders and regulatory authorities.

4.4 Phase 3 - Trial and Approval Phase

The primary objective of Phase 3 is to conduct a formal GEN03 trial to evaluate the effectiveness of Romeo5 Ground as a situational awareness tool within the operational environment. This trial will serve as a comprehensive assessment to determine the system's accuracy, utility, potential vulnerabilities, and to gather feedback and evidence of its practical application. To progress to the trial stage, the development of a safety case may be necessary to ensure compliance with regulatory standards and safety protocols. This is detailed further under section 7, regulatory support.

During the trial, extensive data collection and analysis will be conducted to assess the system's performance across various use cases and scenarios. This will involve real-time monitoring, feedback from operational staff, and the identification of any potential areas for improvement or modifications. The trial phase will also provide an opportunity to validate the system's capabilities under operational conditions and to verify its alignment with the intended objectives.

During this phase we will conduct regular testing, validation, and refinement processes to validate the effectiveness of system enhancements and ensure seamless integration into the operational environment. Assess surveillance hardware for redundancy and to successfully meet coverage requirements requires coverage redundancy requirements and coverage analysis to define the right number and location of antennas and receivers. No specific number of such is provided in the proposal, and our team is committed to working closely with the customer to support the analysis and facilitate communication with the chosen ADS-B antenna/receiver manufacturer. Therefore, please note that the budget does not include provisions for this aspect.

Furthermore, stakeholder engagement and collaboration will be crucial during this phase to ensure that all relevant parties are involved in the trial process. Regular communication with the Civil Aviation Authority (CAA) may be required to ensure compliance with regulatory requirements and standards. The outcomes of the trial will be carefully documented and analyzed to inform decision-making regarding the system's readiness for operational deployment and potential refinements for enhanced performance.

The outcome of this phase will be a system completed and qualified for operations. All elements should be integrated with the operational environment and algorithms and alert should be qualified for operations.

4.5 Phase 4 - Adaptation and Refinement Phase

In Phase 4, the Adaptation and Refinement Phase, the focus shifts towards enhancing the system by incorporating additional functionalities and features based on the feedback and insights gathered from the previous phases. Building upon the success of the trial phase, this stage aims to further optimize the performance and capabilities of the Romeo5 Ground system to meet the evolving needs and requirements of stakeholders.

One of the key objectives of this phase is to introduce new functionalities that may include advanced warning systems, enhanced utilities, or other innovative features that can enhance the system's overall effectiveness and usability. The integration of these new functionalities will be guided by the feedback received from operational staff, users, and regulatory bodies, ensuring that the system aligns with operational requirements and industry standards.

Moreover, the adaptation and refinement phase may also involve the implementation of multiple screens and diverse hardware components to enhance system redundancy and reliability. By incorporating redundancy measures, the system can mitigate the risk of potential failures and ensure continuous operation in critical operational scenarios.

Throughout this phase, close collaboration and communication with all stakeholders will be essential to gather valuable insights, address any identified issues, and ensure that the system's adaptations align with the overarching goals and objectives. Regular testing, validation, and refinement processes will be conducted to validate the effectiveness of the system enhancements and to ensure seamless integration into the operational environment. The ultimate goal of this phase is to deliver a refined and optimized system that meets the highest standards of performance, safety, and reliability.

In addition to the adaptation and refinement of the system in Phase 4, it is important to acknowledge that regulatory considerations play a crucial role in the implementation of new technologies within the aviation industry. As the Romeo5 Ground system evolves and incorporates advanced functionalities, there may be a need for regulatory changes to align with the system's capabilities and ensure compliance with industry standards.

The regulator may require amendments to existing regulations, such as extending CAP670, or the development of a new regulatory framework to address the integration of innovative technologies like the Romeo5 Ground system. These regulatory changes are essential to establish clear guidelines, standards, and protocols for the utilisation of the system within the operational environment, ensuring safety, efficiency, and regulatory compliance.

Collaboration between the system developers, stakeholders, and regulatory authorities will be crucial in navigating the regulatory landscape and facilitating the necessary changes to support the successful implementation and operation of the system. By proactively addressing regulatory considerations and working towards regulatory alignment, the adaptation and refinement phase can pave the way for the seamless integration of the Romeo5 Ground system within the regulatory framework of the aviation industry.

4.6 Phase 5 - Regulatory approval process

In Phase 5, subject to successful completion of prior phases, and suitable endorsement/confidence that Romeo5 Ground can achieve regulatory approval (which may be dependant upon publication of any amendments to existing regulations), a full approval submission will be completed.

This process will utilise all information and evidence gathered during the trial to complete the Safety Assessment Documentation to support an application by the ANSP for regulatory approval of Romeo5 Ground.

5 EGNM General Warranty, Support and Maintenance

5.1 General Warranty

1. Rectifications, patches, updates, and repairs will be provided by DataBeacon to ensure compliance with any specifications requested by the Civil Aviation Authority (CAA) under the CAP670 regulations. This warranty shall remain in effect indefinitely.
2. DataBeacon warrants Romeo5 to be free from software defects for a period of 12 months from the date of installation. Any defects discovered during this period will be rectified by DataBeacon at no additional cost to the customer.
3. DataBeacon also extends the warranties provided by our suppliers for the equipment that is part of the Romeo5 system. The NUC PC is covered by a minimum one-year warranty through the manufacturer, and the ADS-B antenna and receiver are also covered by a minimum one-year warranty through the manufacturer.
4. Any warranty claims must be submitted in writing to DataBeacon within the specified warranty period. DataBeacon reserves the right to inspect the system and equipment to verify the validity of the claim before proceeding with any repairs or replacements.
5. This warranty is non-transferable and applies only to the original purchaser of the Romeo5 software. Any modifications or alterations made to the software without DataBeacon's consent will void this warranty.
6. DataBeacon shall not be liable for any damages or losses incurred as a result of software defects or equipment malfunctions beyond the scope of this warranty. The customer is responsible for ensuring proper maintenance and usage of the Romeo5 system to prevent any issues covered by this warranty.

5.2 Support and maintenance

Our support team is dedicated to providing comprehensive support services to our clients during the warranty period. We offer telephone support during working hours to help diagnose and resolve any issues. Our team will work closely with local ATSEP and operational teams to quickly identify and fix faults. We will also implement a ticketing system to manage support calls efficiently. This system will allow clients to log calls easily and track them with a unique reference number. Our goal is to resolve issues quickly to minimise downtime.

We prioritise testing software updates thoroughly before deploying them to clients' systems. Updates will be tested in our secure cloud environment to ensure they are functional and do not cause any issues. Once approved, updates will go through a change management and approval process before being deployed. Our rigorous testing process ensures updates meet quality standards and do not cause downtime or issues.

We will also offer periodic security updates to ensure systems run smoothly and resolve any critical security breaches or errors. Our team will work closely with clients to implement security upgrades efficiently, minimising downtime and disruption. We understand the importance of keeping systems secure and up-to-date, which is why we offer this service as part of our ongoing support options.

6 EGNM Delivery Schedule

We provide an estimated schedule with the goal to have a system fully operational during winter 2025. This schedule includes all elements of customisation, internal testing, acceptance testing, shipping, and necessary mapping customisations to ensure the system is fully functional upon delivery. Our design process ensures that the final system is first deployed on a web environment for approval, simplifying feedback from our customers and ensuring deadlines are met. When certain maturity is achieved, the same system gets deployed on-premise, combining agility on the iterations and reviews/approvals from the customer with final regulatory compliance.

Week	Milestone	Description and follow up steps.
0	Order received from customer.	Acknowledgement of reception and confirmation of the schedule. **Phase 0 starts.** DataBeacon would request the customer data to customise the maps and different layers to be display.
1	ADS-B equipment (antenna(s) and receiver) ordered	Antenna(s) and receiver(s) will be ordered for delivery to the customer. DataBeacon will provide and loan a single pre-configured ADS-B antenna for the Phase 0 period.
2	Reception of customised data	Customer should provide customised information for the first map design.
3	Antenna(s) and receiver(s) delivered.	
4	Antennas and receivers expected to be installed at the airport.	Leeds Bradford Airport will install the antenna at a suitable location with significant visibility over the airport platform and configure it to the required network/internet settings with support from DataBeacon.
6	Cloud Romeo5 Ground candidate to be validated with customer.	DataBeacon will receive live data from the antenna and incorporate it into a cloud-based **Romeo5** display, accessible via a browser. The Romeo5 cloud version is an early delivery with the primary objective of ensuring that the equipment and first user interface system meets the desired functionality, technical specifications, and trigger additional design requirements outlined by the client. The display will provide a ground layout of the Leeds-Bradford airport and will allow the customer a first evaluation of Romeo5 and discuss internally the kick-off of the following phases of the project.
10	**Phase 1 starts**	Requirements collection and coverage assessment. Collaborative online sessions with the customer to gather requirements and specifications by the customer. Design, development and testing will follow.
11	GEN03 Trial preparation	Develop and submit details of the proposed GEN03 Trial to the CAA. Refinement and review of the trial will be completed within timescales provided by the CAA.
14	FAT candidate deployed on-premise	The custom system will be deployed locally within the airport premises, albeit not within the Visual Control Room, allowing the customer to engage with stakeholders, including end-users and regulatory bodies. Concurrently, safety assurance and the initiation of the regulatory case will be integral components of this phase.
15	Review of FAT candidate and potential modifications.	Testing, validation, and assessment of the system's utility, coverage, reliability, and the identification of any unforeseen requirements that may arise before the system is fully operational. Additional development to accomodate for the results of the review might be needed from this phase.
18	FAT candidate approved.	A report with the results of the FAT candidate will be review and DataBeacon will monitor remotely the performance of the system to ensure compliance with specifications.
20	**Phase 2 starts**	Installation and testing of the Romeo5 Ground system within the Visual Control Room (VCR). Operational teams to assess its functionality, usability, and effectiveness in enhancing situational awareness within the control room.

24	Results of testing Phase 2 collected	Phase 2 feedback and new requirements are frozen. Preparation of Test Plan for the FAT that outlines the procedures, test cases, acceptance criteria, and responsibilities.
25	FAT	Execute the FAT according to the test plan.Thoroughly document all observations, test outcomes, and identified discrepancies during the FAT.
26	**Phase 3 starts**	Formal GEN03 trial to evaluate the effectiveness of Romeo5 Ground as a situational awareness tool within the operational environment. This trial will serve as a comprehensive assessment to determine the system's accuracy, utility, potential vulnerabilities, and to gather feedback and evidence of its practical application. To progress to the trial stage, the development of a safety case may be necessary to ensure compliance with regulatory standards and safety protocols.
32	**Phase 4**	Adaptation and Refinement Phase, the focus shifts towards enhancing the system by incorporating additional functionalities and features based on the feedback and insights gathered from the previous phases. Building upon the success of the trial phase, this stage aims to further optimize the performance and capabilities of the Romeo5 Ground system to meet the evolving needs and requirements of stakeholders.
34	Final FAT, shipment of Romeo5 hardware, software and user and technical manuals.	After performing the Factory Acceptance Test (FAT), the results are thoroughly reviewed internally to identify any problems. If necessary, corrective actions are taken to resolve these issues and, if necessary, further testing is performed to ensure the effectiveness of the corrective actions. Upon successful completion of the tests and resolution of the problems, all documentation, including the FAT report and other relevant documents, is finalised. The FAT results are presented to the customer for review and approval, ensuring that they meet the customer's expectations. Following customer approval, arrangements are made for delivery and installation of the Romeo5 equipment, as well as technical and user manuals.
36	Site Acceptance Test (SAT). Finally qualified system.	The Site Acceptance Test (SAT) ensures the installed equipment or system meets specified requirements in the operational scenario. It involves on-site testing, validating system integration, performance, and compliance. Coordination with the customer will be needed to establishes a testing schedule and protocol as well as test execution. These tests will be performed on-site by the customer in collaboration with DataBeacon. Its successful completion will be formally documented, signifying full handover, and delivered as a sign of customer approval of readiness for operational deployment.
36	**Phase 5 starts**	All necessary information and evidence is gathered and collated to support preparation of the Safety Assurance Documentation. Significant stakeholder input will be required to support this process.
40	Presentation of Safety Assurance	A draft safety assurance document will be presented to the ANSP for review and comment. Revisions will be made as required to finalise ready for regulatory submission.
42	Regulatory Submission	The final regulatory approval request will be submitted for consideration by the regulator. Beyond this point, timescales will be primarily dictated by the regulators response, and scope of any amendments or adjustments to the submission to achieve full acceptance and approval.

7 EGNM Regulatory Support

The use of Romeo5 as a Ground Based Flight Information Display is potentially outside the current scope of CAP670 regulations.

To assist with the application to the CAA for the introduction of Romeo5 Ground, Databeacon is able to support the process with assistance from DZ Aviation consultancy.

This liaison forms an integral part of two phases,

7.1 Phase 3 - GEN03 trial

DZ Aviation will work jointly with DataBeacon to assist Leeds in engagement with the CAA to prepare and submit the GEN03 trial documentation to seek approval for this trial. Key components of this will include:

- Objectives of the trial
- Technical descriptions
- Operational impacts
- Safety Case
- Timelines
- Reporting and Feedback mechanisms
- Regulatory Compliance
- Stakeholders

7.2 Phase 5 - FID Approval

In the event that the CAA are accepting of the trial outcomes, and confirmation that the FID can be used for Ground Situational Awareness, development of the safety assurance documentation will be provided to support the application for CAA approval under UK Regulation (EU) 2017/373 for the proposed Flight Information Display System.

This can include,

- Assisting in liaison with the CAA regarding the extended use of Romeo5 FID. This may include liaison with CAA Policy and CAA ATS Inspectors.
- Assess the proposed FID as a change to the Functional System in accordance with the ANSP Change Management Process.
- Develop Safety Assurance Documentation.
- Liaise with the ANSP to assist with incorporation of training and competence requirements into the UTP.
- Approval Submission and additional revisions as required (maximum 3 revisions, further subject to quotation).

Due to the unknown response from the regulator and method by which the regulator may stipulate approval requirements, no assurance can be provided as to the outcome of discussions and any eventual approval submission, however every effort will be made to support the process throughout.

8 EGNM Financial proposal

To facilitate clear financial planning, we propose an itemised fixed total price, encompassing the software, hardware, antennas and receivers, and regulatory processes.

Our pricing is determined using a combination of factors including hardware costs, anticipated development/setup time, Air Traffic Service level, Designated Operational Coverage and commercial/non-commercial movements figures.

This approach provides transparency and certainty, ensuring that the airport can confidently plan and budget for this enhancement.

Please note that this is a preliminary proposal intended to initiate discussions. DataBeacon does not commit to the pricing outlined in this proposal, and reserves the right to adjust pricing should circumstances change. Databeacon is able to discuss alternative terms and payment arrangements to that proposed below. Thank you for your understanding.

8.1 Phase 0 - Proof of Concept

Each Party agrees to bear its own costs and expenses incurred in relation to the activities under this Phase 0.

8.2 Phase 1 - System development

The quoted work includes the customisation of the Leeds-Bradford ground environment, including all required visual elements and functions. The work will start by a review of existing requirements applicable under the CAP-670 regulation and a series of online interactions with the customer along with data gathering to build the first prototypes of the system. Additionally work will commence to prepare and submit documentation to support the CAA approval of the Phase 3 GEN03 trial.

1) System Development Phase	Total: £45,000
Hardware: PC, network switch, time server	£5,000
Candidate software system Romeo5 Ground Leeds-Bradford	£40,000
Preparation of GEN03 Trial Submission	£18,000

8.3 Phase 2 -Testing phase

The quoted work includes support for the installation and testing in the VCR, all necessary data analysis required, review with the team, and evaluation of the results. The work also includes all the necessary changes to the system as a result of new requirements from the regulator or from the users, including visual modifications, new layout layers, or functionalities requested by the team that are needed for installation in the VCR. The goal of this phase is to understand what modifications or enhancements are needed to get an approval by the regulatory authority, ensuring compliance and approval for the system.

2) Testing Phase	Total: £20,000
Support to installation and testing campaigns Modifications to the system after testing	£20,000

8.4 Phase 3 - Trial and Approval phase

The quoted work includes the support to conducting a formal trial to evaluate the effectiveness of the Romeo5 Ground system as a situational awareness tool within the operational environment. Other activities part of this phase will also be collecting and analysing extensive data to assess the system's performance across various use cases and scenarios, including real-time monitoring and feedback from operational staff. Documenting and analysing the outcomes of the trial to inform decision-making regarding the system's readiness for operational deployment.

3) Trial and Approval Phase	Total: £20,000
Support to trial and approval	£20,000

8.5 Phase 4 - Adaptation and Refinement Phase

Addressing regulatory considerations and potential changes to regulations to align with the system's capabilities and ensure compliance with industry standards will be the main focus of this phase. Collaborating with stakeholders and regulatory authorities to navigate the regulatory landscape, facilitate necessary changes, and ensure regulatory alignment for the successful implementation and operation of the system within the airport operational environment.

The quoted work includes potentially incorporating additional Functionalities that may have appeared and had been tested during Phase3, such as advanced warning systems, enhanced utilities, or innovative features based on feedback from operational staff, users, and regulatory bodies.

Part of this phase will also be implementing multiple screens and diverse hardware components to enhance system redundancy and reliability, mitigating the risk of potential failures. Additional hardware for additional redundancy or to successfully meet coverage requirements would require modifying the budget. Surveillance hardware for redundancy and to successfully meet coverage requirements requires coverage redundancy requirements and coverage analysis to define the right number and location of antennas and receivers. No specific number of such is provided in the proposal, and our team is committed to working closely with the customer to support the analysis and facilitate communication with the chosen ADS-B antenna/receiver manufacturer. Therefore, please note that the budget does not include provisions for this aspect.

The quoted work also includes additional hardware for redundancy and a license for Romeo5 Ground for 5 years:

4) Adaptation and Refinement Phase	Total: £135,000
Adaptation and refinement of R5 GA	£30,000
Additional hardware	£5,000
License 5 years	£100,000

8.6 Phase 5 - Regulatory Approval Process

Due to the unknown extent of scope of work required that may be stipulated by the regulator, the below figures are estimates only and will be subject to refinement and review throughout the process. Additional support work may be sub-contracted out where specific expertise may be required to help support the process.

5) Regulatory Support	Total: £17,700
Application Preparation and Approval Submission	£13,200
Approval Review and Revisions (2 rounds)	£4,500

8.7 Summary

1. System Development Phase	£45,000
2. Testing Phase	£20,000
3. Trial and Approval Phase	£20,000
4. Adaptation and Refinement Phase	£135,000
5. Regulatory Support	£35,700
Total	**£255,700**

Not included:

- Computer screens and other computer accessories.
- ADS-B antenna/receivers provision and installation. Estimated cost of the antenna + receiver £1,000 per unit.
- Local installation and computing setup on the VCR.
- Taxes, shipping