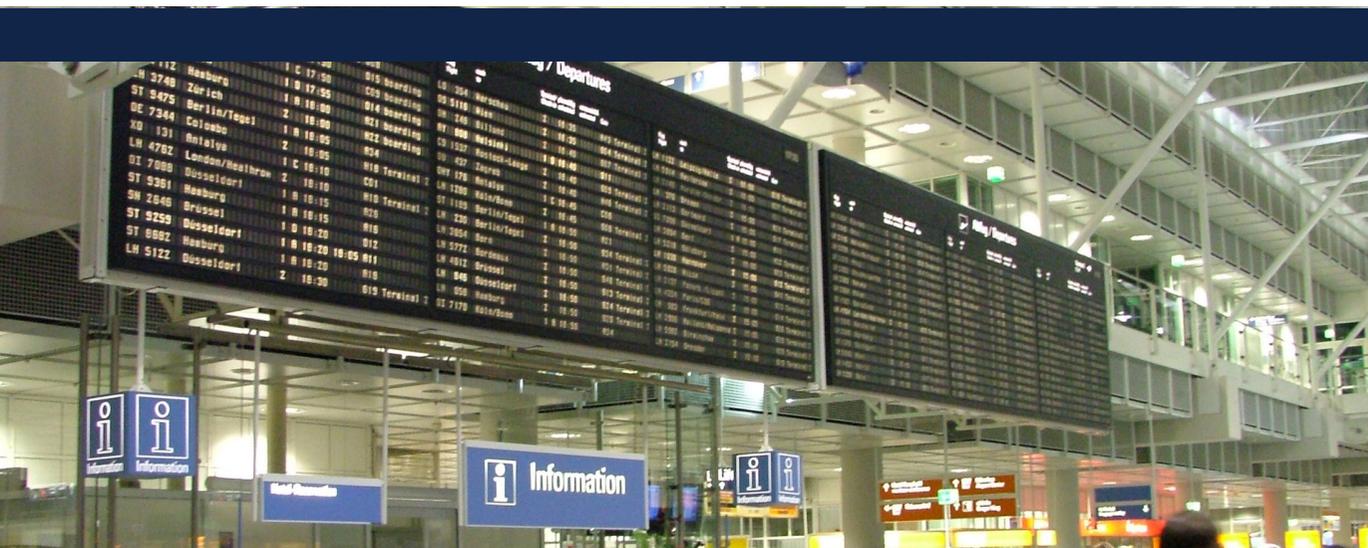




# TECHNOLOGY



**Aviation Consultancy at its best.**

Specialist aviation support solving problems for airports and airport developers

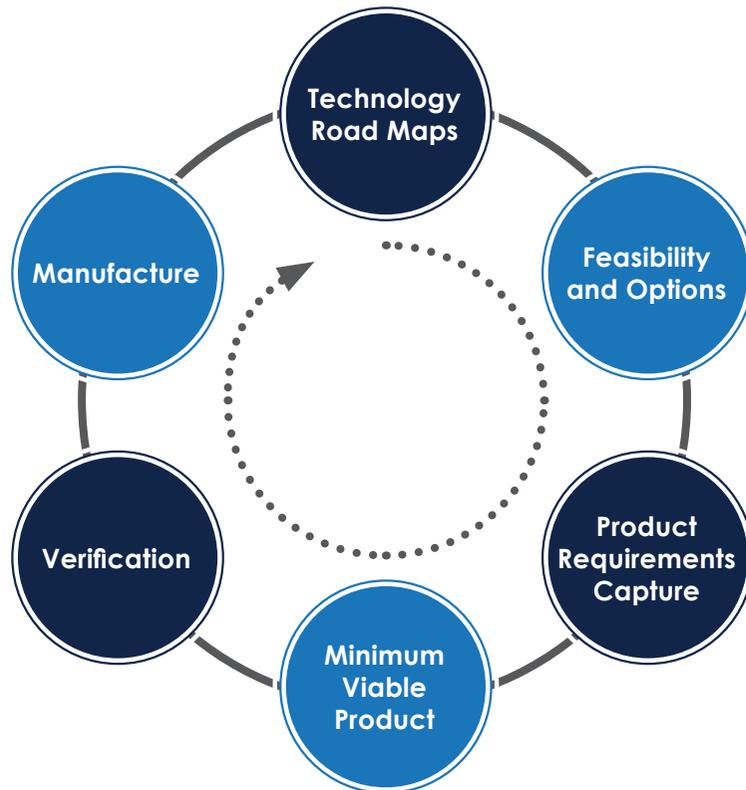
 [www.cyrrus.co.uk](http://www.cyrrus.co.uk)

# INSIGHT AND INNOVATION

Through experience and innovative solutions, Cyrrus has developed technology for airports that realise business benefits otherwise denied by conventional thinking.

Cyrrus expertise includes many years of experience as civil and military air traffic controllers, air traffic engineers, commercial and project managers at international airports. This experience ensures Cyrrus has up-to-date knowledge of 'real-world' issues and provide high-value engineering solutions.

Innovative technology often starts as an immature idea or basic concept. Choosing a partner that understands the application of technology, industry constraints and recognises the opportunity is essential to delivery of a final product. Cyrrus staff help navigate complex ideas and collate into executable business and development plans. Our safety engineers guide your development ensuring compliance with statutory and regulatory requirements. Systems engineers develop your solution and remain at the core of the development lifecycle.



## OUR TECHNOLOGY

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Our experts have designed several innovative solutions for the Air Traffic Management (ATM) industry. These technology components integrate with existing systems, to address technology constraints or meet regulatory requirements. Cyrrus has technology patents for two such components; a radar data processing system to address windfarm interference to Primary Surveillance Radar (PSR) and a Mode-S code conflict detection and performance monitoring system.

Cyrrus staff have extensive ATM domain knowledge, experience and insight to deliver innovative, cost effective solutions. Whether using our own components or other Commercial-Off-The-Shelf items, Cyrrus has the building blocks to provide solutions that meet today's demanding Operational Requirements. Our solutions take advantage of new technologies and operational procedures, rather than 'like-for-like' replacement of legacy equipment.



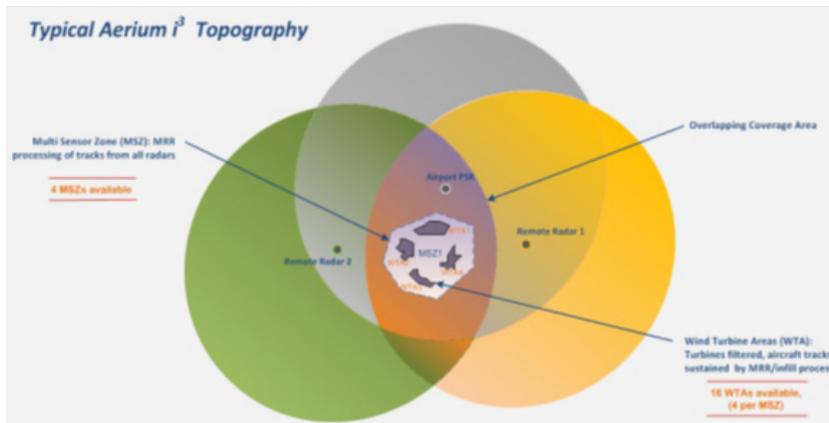
# OUR PRODUCTS

## AERIUM™

Operating on the high integrity purpose built Cyrrus Universal Surveillance Platform (CUSP) hardware, AERIUM has several variants ranging from simple data format conversion to the patented SMARTENER™ algorithm that overcomes corruption of aircraft detection due to wind turbines.

The AERIUM™ product range provides flexible and future proof solutions for surveillance data integration. AERIUM™ supports multiple surveillance formats and sources (RDIF, ASTERIX, PSR, SSR, 3D PSR, Mode S, ADS-B etc). Using the range of products, customers can extend the use of existing surveillance processing systems, while taking advantage of new sensor technologies.

AERIUM™ i3+ uses patented SMARTENER™ processing <http://www.cyrrus.co.uk/portfolio-items/cyrrus-radar-mitigation-technology-overview/> enabling wind farm developers to avoid costly mitigation projects and lifetime maintenance costs, while providing safety assured surveillance for airports. SMARTENER™ processing may also be used to improve radar coverage and remove clutter.



### Aerium i<sup>n</sup> Series Products ...

Function	Aerium Integrated Intelligent Infill			
	Aerium i <sup>1</sup>	Aerium i <sup>2</sup>	Aerium i <sup>3</sup>	Aerium i <sup>3+</sup>
Format conversion	✓	✓	✓	✓
Interface conversion	✓	✓	✓	✓
Plot Assignor Combiner		✓	✓	✓
Principal & Fall-back Remote Sources		✓	✓	✓
Dual Redundant Architecture option		✓	✓	✓
2D Turbine Mitigating Radar Integration			✓	✓
3D Turbine Mitigating Radar Integration			✓	✓
Remote ATC Radar Integration			✓	✓
Seamless Infill Processing			✓	✓
Intelligent Infill Processing				✓
Wind Turbine Filtering				✓

With the SMARTENER™ algorithm, seamless tracking of aircraft across boundaries is a reality; no reduction in surveillance radar coverage, no boundary issues, no track discontinuities and radar performance is maintained. In addition, SMARTENER™ meets all the safety assurance requirements of the European and US aviation industry.

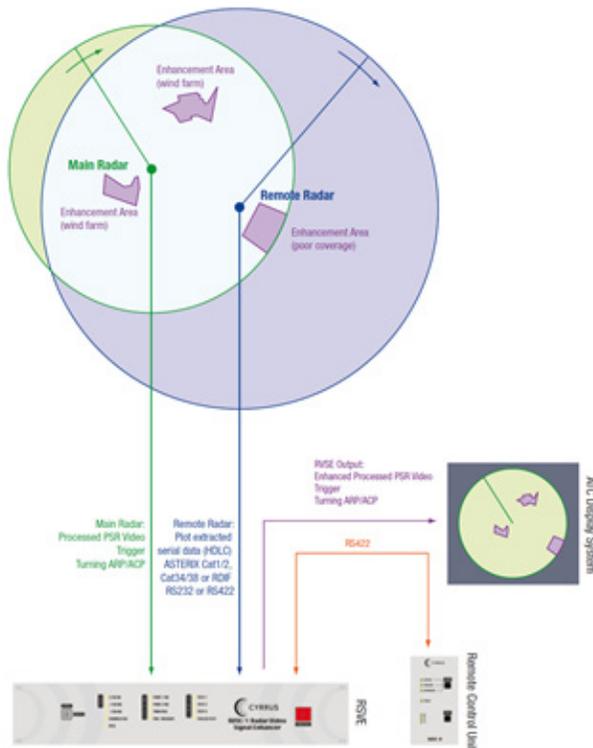
# OUR PRODUCTS

## Radar Video Signal Enhancer (RVSE)

High levels of clutter or poor coverage can prevent older airport PSRs from meeting operational and regulatory requirements. This can inhibit construction projects or limit Air Traffic Operations. The RVSE enables these areas to be removed and a substituted with an alternative remote radar source. The result is a truly seamless, time synchronised display for Air Traffic Control (ATC) <https://www.youtube.com/watch?v=EKSuOCWPUzc>.

Over wind farms, the RVSE is a unique product that provides ATC with a clear 'radar video' presentation of aircraft tracks, leaving the display free of clutter generated by the turbines <http://www.cyrus.co.uk/wp-content/uploads/2016/09/Cyrus-RVSE-Tech-Sheet.pdf>. In areas where PSR coverage is poor, the RVSE is a cost-effective method of integrating the radar picture with an alternative radar source.

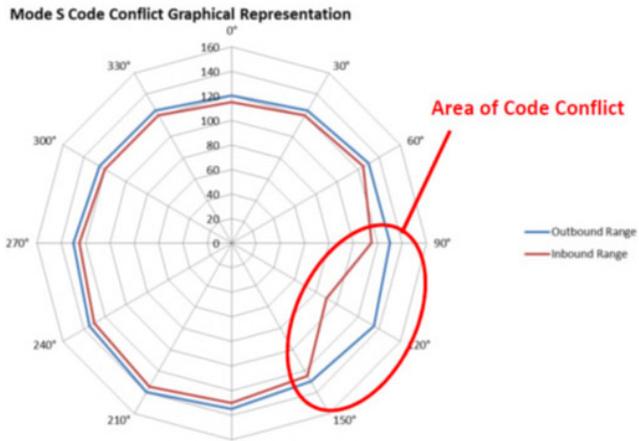
RVSE is designed for analogue 'radar video' PSR where a plot extracted infill PSR is available and does not require secondary surveillance data.



# OUR PRODUCTS

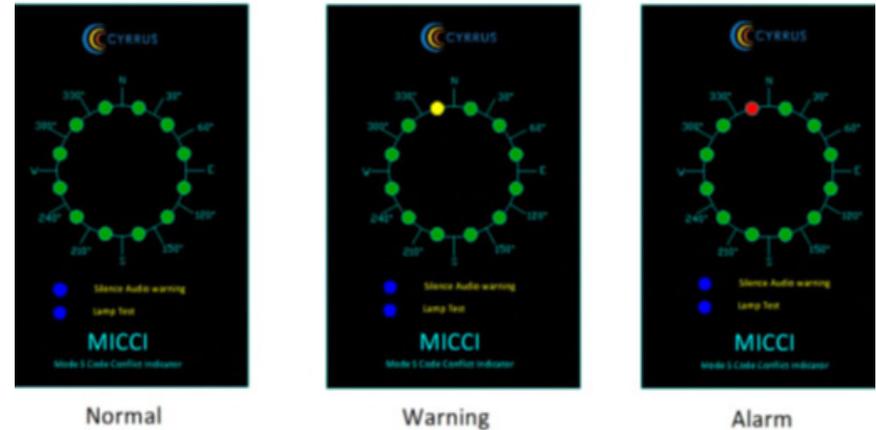
## Mode S Interrogator Code Conflict Indicator

The patented Mode S Interrogator Code Conflict Indicator (MICCI) solution detects conflict between Mode S Secondary Surveillance Radars (SSR) with overlapping 'Lock-Out' maps, that result in the loss of aircraft detection. MICCI operates in real-time and only requires radar data from local Mode S radar to detect a problem. The small rack mounted unit accepts legacy serial or IP based data and displays at the ATC workstations clearly indicate regions of potential conflict.



MICCI detects general loss of Mode S SSR performance, providing qualitative safety assurance that the surveillance system is operating correctly. Installation of MICCI make Mode S SSRs fully compliant with UK Civil Aviation Authority (CAA) and European Regulation for real-time monitoring of surveillance systems.

## Example - MICCI 12 Segment Warning Panel



## Scenario Test Generator

To verify the performance of the AERIUM™ products, Cyrrus developed a Scenario Test Generator (STG). Operating on the CUSP platform, the STG is configured to generate specific radar tracks and output in All-Purpose EUROCONTROL Surveillance Information Exchange (ASTERIX) or other formats. This flexible solution enables developers to fully stress surveillance data processors and qualify products using independently recognised surveillance analysis tools. While meeting an internal requirement, the STG has developed into a powerful tool that can be used in a range of applications such as testing of windfarm mitigation processing, testing of safety nets and real-time impact simulation.

# PLANNING FOR THE FUTURE

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The exploitation of technology in the ATM domain requires the application of skills, methods and processes to deliver a capability that ultimately meets an Operational Requirement. Indeed, appropriate technology delivers improved performance of the wider system. The Single European Sky ATM Research (SESAR) and Next Generation Air Transportation System (NextGen) programmes actively pursue new technologies that will deliver an improvement in global ATM. These major, state sponsored programmes, are ambitious and have cost millions of pounds to develop. Today, application of these solutions at Airports deliver real business benefits without excessive cost.



## Capital Expenditure

Having a clear understanding of the costs associated with supporting airport technology and airport operations in the medium to long term is essential. On many occasions, Capital Expenditure (CAPEX) has been on a case-by-case direct replacement basis. A robust CAPEX programme must start with the future operational and business needs of the airport. The existing asset condition and regulatory changes must also be understood. Together they inform a CAPEX programme that allows airports to effectively plan the replacement and upgrade programmes.

Cyrus provide professional advice on all aspects of CAPEX development for ATM systems and airfield infrastructure. This includes Communications, Navigation and Surveillance (CNS), runway and paving surfaces, aeronautical ground lighting and associated operational buildings.

Using our Flowmax airspace modelling tool, we work with airports to explore options for increasing airport capacity by changing Airspace designs, deploying new PBN based instrument flight procedures (IFP) and upgrading traditional navigational aids. Our recognised expertise in CNS replacement, Airspace and IFP design will enable Airports to include these costs in their CAPEX plans.

# PLANNING FOR THE FUTURE

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## **Asset Condition Surveys**

Cyrrus has completed several ATM asset condition surveys for major international airports. The surveys examine the systems, supporting power and communications, documentation, safety assurance, spares and test equipment, as well as staffing levels and fault response. Working with airports and ANSPs, the surveys aim to improve asset quality, reduce fault response times and reduce maintenance costs.

Survey results benefit the ANSP and airport operator, by delivering a prioritised list of observations and recommendations. Our reports are also used to demonstrate to National Regulatory Bodies that maintenance of air traffic control related assets is actively being addressed.

As a pre-cursor to tendering for the ANSP services, it has proven essential in establishing the system boundaries, ownership, transitional arrangements and maintenance requirements.

Through carefully chosen partnerships, Cyrrus can survey the engineering assets and functions across the airport. These audits inform CAPEX plans for terminal building and airfield based assets. These wider conditions surveys are invaluable during the due diligence process of airport procurement.

# SYSTEM DESIGN

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Cyrrus delivers ATM solutions and has identified niche areas where significant benefits are realised from new technology. Cyrrus ATC and Systems Engineering experts, understand both military and civil ATM Operational Requirements, delivering lean and scalable solutions. Our rigorous 'Stage Gate' process and development lifecycle, ensure controlled delivery and development. Cyrrus take customer ideas and deliver safety critical technology solutions together with supporting safety assurance documentation.

Cyrrus specialises in CNS and ATM programmes. This highly demanding and competitive market demands engineering and project management excellence, an environment within which Cyrrus has established a respected and recognised capability. Company personnel have a wealth of engineering and operational experience and offer services and advice to airport operators, air navigation service providers and airport developers.

## Communications

The communications domain is rapidly changing with the introduction of modern Voice over Internet Protocol (VoIP) systems. This new technology, together with the application of datalinks, is a significant leap in how communications are used.

Our background in airport communications and the complexities of large scale communication system design, ensure the appropriate technical solutions are delivered to meet your operational needs.



# SYSTEM DESIGN

## Navigation

Satellite based procedures remove the need for most airport navigational aids, but legacy equipment remains at the forefront of airport operations. Our world respected Instrument Landing System designers have delivered solutions that many considered impossible. Signal in Space experts, linked with refined Safeguarding procedures, ensure navigation system designs that meet the most stringent requirements in the most difficult of circumstances.



## Surveillance

Surveillance system design is at the forefront of the Cyrrus engineering capability. Cyrrus design surveillance systems that deliver real operational benefit. From site selection through to

acceptance testing and flight trial management, Cyrrus will ensure a surveillance system is delivered and optimised for the specific customers need.



## Fibre Optic and Copper Networks

Airport data communications infrastructure requires careful long-term planning and a phased approach linking to other CAPEX projects to realise real cost savings. Cyrrus specialise in fibre optic and copper cable based designs to accommodate current and future data interfaces. Our solutions deliver the capacity and redundancy essential for safety critical systems.

# TRAINING

Cyrrus offer a range of technical courses for engineering teams to understand the wider context of ATM developments and their practical application. Courses can be traditional classroom based or delivered as e-learning. Qualified instructors develop courses to meet specific customer requirements, ensuring learning outcomes meet the exact training need.

## Air Traffic Safety Electronics Personnel (ATSEP)

Recognising the need for a common approach to training and competency, EUROCONTROL has developed a framework in ESARR 5. Cyrrus provide Basic and Qualification level courses in surveillance and navigational aids. Tailored courses are also available for non-technical staff to gain an understanding of the technology associated with the provision of air traffic services.

## Surveillance

The ATSEP Qualification Level surveillance course covers traditional PSR and SSR, including Mode S. The course also covers more modern airport and Wide Area Multilateration systems, ADS-B and 3D sensor technologies. The course incorporates the principals and key elements of a Surveillance Data Processor system.

## Instrument Landing System

This intensive ATSEP Qualification Level course covers the performance analysis of glide path and localiser systems. It addresses the effect of slopes in terrain, antenna feeds and mechanical alignment of antenna systems. Those attending will understand the association between monitor readings and the

signal in space. This course will benefit maintenance and project engineers by providing product independent knowledge and understanding.



## Safeguarding

Cyrrus prides itself on the Safeguarding process and knowledge within the Company. As such, our staff are well versed in providing Safeguarding training for airport staff at all levels. On completing the course, attendees will understand the potential impact of developments in and around the airport. The training covers continued safe operation through effective mitigation techniques.

# TEST AND COMMISSION

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## Commissioning

Systematic CNS system optimisation ensures maximum performance is delivered. By creating detailed design documentation, commissioning engineers have clear objectives. For surveillance systems, the optimisation process is crucial in delivering target detection while avoiding false tracks and clutter; an area not always adequately addressed by suppliers due the high costs of optimisation. Cyrrus provide truly independent advice to ATC on performance trade-offs in challenging environments.

## Acceptance Testing

Acceptance testing verifies the equipment and the wider system performance against the specific requirements. Our rigorous apportionment of these requirements to suppliers provides measurable acceptance criteria, protecting the technical and commercial aspects of a project. Our specialist engineers define, validate or witness Factory and Site Acceptance Tests. Cyrrus industry knowledge and experience resolve non-conformance and support associated commercial negotiations.

## Surveillance Sensor Performance

Cyrrus design and manage flight trials to verify the installed system delivers the defined operational and regulatory requirements. Using recognised industry analysis tools, our surveillance reports provide the quantitative evidence that is an essential part of the safety assurance process. Where equipment suppliers provide flight trial reports to customers, Cyrrus evaluate the assumptions and applied parameters to independently validate flight trial reports.

## Compliance

As part of our standard project process, Cyrrus use Verification Cross-Reference Matrices to track statutory, business, user, functional and regulatory requirements. A project VCRI is updated at design reviews, factory and site acceptance tests and other key milestones. It demonstrates compliance to national regularity bodies and supports milestone payments in commercial agreements.



# TEST AND COMMISSION

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## Technical Handover

Engineering teams must have the appropriate training and competence to ensure the delivered system will continue to meet its performance requirements. Our training needs analysis establishes the training requirements at the start of a project. The requirement for spares, technical manuals, parameter settings and specialist tools must also be determined. At Technical Handover, Cyrrus will confirm these requirements are met.

Maintenance support contracts with agreed Service Level Agreements are in essential in meeting system availability and business needs. Cyrrus determine the scope and SLAs required for support contracts based on the level of service required and safety assurance assumptions. At Technical Handover maintenance teams, can be confident that the appropriate level of support is in place.

## Operational Handover

Transition of systems into operational service requires careful planning with clear tasks, milestones, roles and responsibilities. Working with ANSPs and Airport owners, Cyrrus develop Transition Plans with operational risk assessments and mitigations that support the safety management process. Our robust Transition Plans accommodate the most demanding requirements to maintain operations during the transition process.



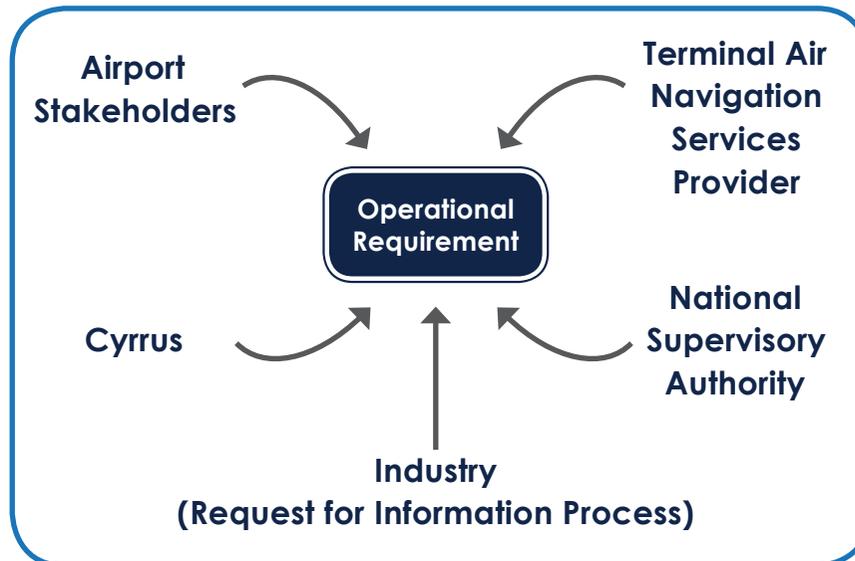
# REQUIREMENTS ENGINEERING

By employing industry recognised systems engineering process, Cyrrus deliver fit-for-purpose, safe and cost-effective solutions meeting the customer's technical and business needs. Solutions are delivered in a controlled and structured manner to ensure on-time and on-budget delivery.

Cyrrus use SMART requirements without dictating the solution to maximise supplier choice. Our independent advice secures future proof technology and value for money, avoiding the simple like-for-like replacements that often fail to deliver new opportunities.

## Operational

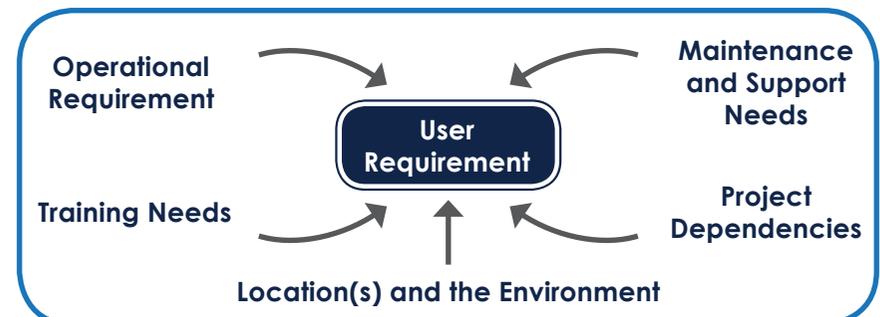
Cyrrus will work with customers to understand their business objectives and operational needs.



We do not apply a 'one size fits all' mentality: Each Operational Requirement is different and the surrounding environment and circumstances often call for alternative approaches. Cyrrus understand Air Navigation Service Provider and National Supervisory Authority (NSA) requirements and practical implications. Cyrrus develop Concepts of Operation into the validated Operational Requirements that form the foundation of any project.

## User

User Requirements Specifications expand on an Operational Requirement by providing a boundary to the requested solution. The URS specifies the locations, assumptions, dependencies and identifies the maintenance, training and support needs. The URS forms the basis of more detailed technical and process requirements.



# REQUIREMENTS ENGINEERING

## Regulatory

Although commonly referred to as a heavily regulated industry, the aviation sector is no different than many technical domains. The NSAs of any country follow the overarching guidance produced by the International Civil Aviation Organisation. In Europe, this is further evolved through the European Aviation Safety Agency. Each of the individual NSAs maintain extant regulation that must be complied with during technology projects.



Along with regulation, Cyrrus regularly review emerging regulations that aim to address specific changes, such as the 8.33kHz channel spacing requirement. A true future proof solution will consider the emerging regulation and industry thinking from programmes such as SESAR and NextGen.

## Safety

Unlike the IT market, changes in ATM procedures, processes and technology take many years to adopt. Any new technology must support the need to transition into operational service, often requiring an ability to interface with legacy systems. All

technologies must mitigate against failures, whether within the technology itself or as part of the wider system resilience. In most scenarios, mitigations are required to meet the target level of safety. Cyrrus ensure that qualitative verification is feasible to fully justify safety assurance and performance claims - something overlooked by many embedded software derived technologies. Our system engineers will ensure integration with existing systems and provide practical solutions for transition into service.

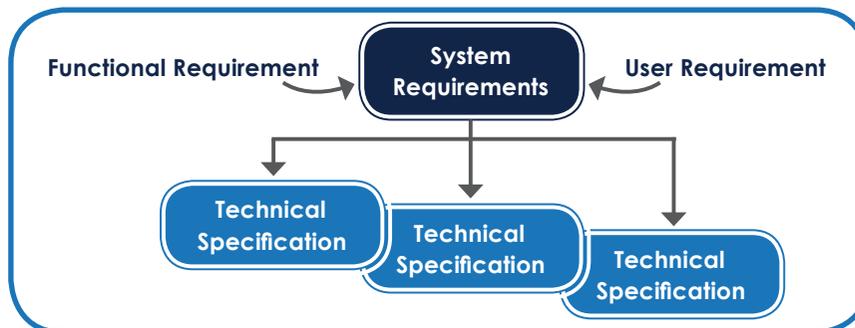


# REQUIREMENTS ENGINEERING

ATM Safety Management Systems (SMS) maintain the integrity of the aviation industry and reassure the travelling public that their safety is the number one priority. Safety work is often viewed as highly specialised particularly with respect to Safety Case development. Cyrrus are able to support organisations across the full range of safety assurance activities, from ad-hoc support to in-house projects, through to full SMS implementation and complex 'multiple system' Safety Cases. Our approach is to ensure we bring the very best technical expertise allied firmly to an operational focus.

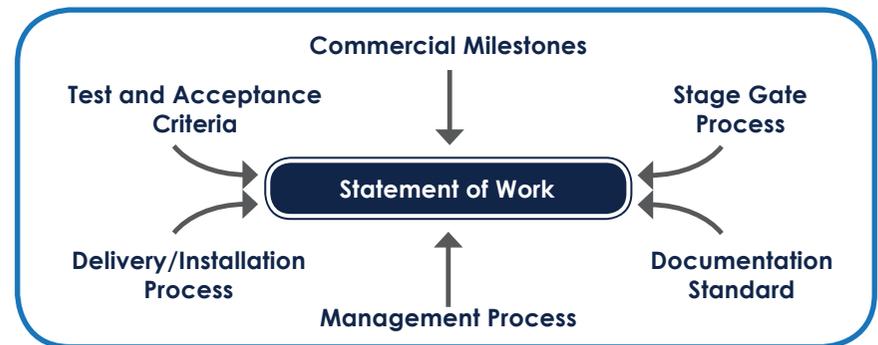
## Technical

Project technical requirements are produced within a System Requirements Specification. This formally details the technical requirements that must be met and will be confirmed prior to formal acceptance. Where a project requires separate systems to meet the overall need, Technical specifications highlight specific formal requirements that can be met by individual suppliers.



## Process

Often overlooked by procurement projects, the way new equipment is delivered into operational use is a key component of the safety assurance activity. A Cyrrus Statement of Work formally details the process to be used from award of contract through to entry into operational service and through-life support. Adherence to the SoW provides significant evidence in the generation of supporting safety documentation and confidence in the commercial arrangements of any contracts.



## Business

Shareholders and boards of directors set the overall business aims and objectives. Airport Master Plans provide details of future expansion and planned business development opportunities. Cyrrus help executive teams understand the constraints and dependencies to ensure robust business planning. Business requirements and risks form an essential part of the requirements capture phase of our projects.

# WHY CHOOSE CYRRUS

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## Cyrrus – Your Technology Specialist

- In-house technology components to mitigate real-world issues.
- Proven technology partner, with a wealth of experience in the definition, design, specification and delivery of the full range of CNS/ATM systems.
- One-stop shop for all CNS/ATM technology needs, including full safety assurance, training, operational validation and project management
- Thorough understanding and use of industry best practice Systems Engineering process.
- Expert knowledge of procurement methodologies to realise significant savings over single source purchase.
- Proactive project management and stakeholder engagement.





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