HOW TO INCENTIVISE INNOVATION IN ATM?

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Introduction

The Airspace Architecture Study (AAS) proposed a transition to a distributed architecture enabling significant performance increases in the European Air Traffic Management (ATM) system. Successful transition requires service providers to adopt new technologies, operational concepts and business models.

The architecture proposed by the AAS is based on three operational layers including the notion of a new form of service provider– the ATM Data Services Provider (ADSP) - which would enable certain services currently provided within an area control centre to be provided remotely.

This white paper is a summary of the findings of Project RoMiAD (Role of Markets in AAS Deployment)– catalyst project of SESAR's Engage Knowledge Transfer Network, which considered how ATM cost efficiency can be increased through adoption of the AAS architecture and how the necessary transition can be incentivised.

Acknowledgements

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Innovation, Digitalisation and Virtualisation

Virtualisation is a specific form of digitalisation proposed in the Airspace Architecture Study as a path to enable moving from the current architecture to organisational collaborations (or horizontal integration) at the Air Traffic Services (ATS), Common Data and Physical layers creating a basis for further and faster innovation on ATM.

Current architecture

Currently, the ATM system is a patchwork of national air navigation service providers (ANSPs) operating vertically integrated systems. A single organisation therefore typically provides all the necessary services – from the auxiliary services (services with a geographical dependency such as Communications, Navigation, Surveillance, Aeronautical Information Services (AIS) and Meteorological Services (MET)) to ATS. Airspace is mostly organised by national boundaries. Flight data is held locally in the ATM System (or Flight Data Processor (FDP)) – with limited sharing of data between neighbouring Area Control Centres (ACC) leading to restricted interoperability.

The technical limitations of the current architecture, limit overall capacity as well as flexibility, scalability, resilience and coordinated deployment of new ATM functionalities. The national ANSPs have however formed different forms of alliances to support collaborative modernisation such as procurement alliances and operational alliances. The AAS proposes a new architecture that builds on the success of these alliances.

Future architecture

The future system (see Figure 1) proposed by the AAS breaks down the current vertically integrated systems to enable a more efficient set of services to be integrated horizontally.

The long-term goal is to realise a single gate-to-gate Trajectory Based Operations (TBO) concept enabling optimised, predictable, cost-efficient, and sustainable flights across Europe and optimisation of airspace at network level.

The proposed architecture envisages three levels with the potential to create markets:

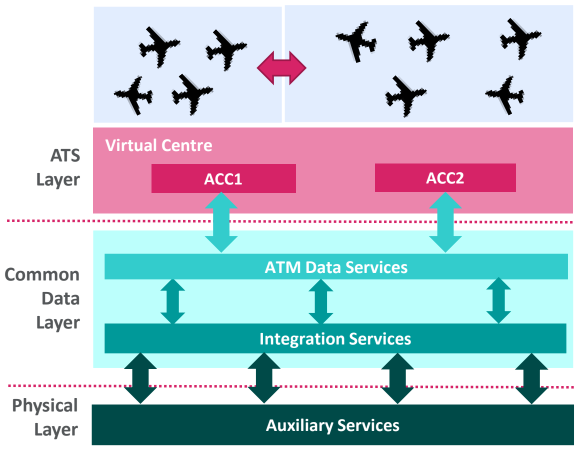

FIGURE 1: FUTURE ARCHITECTURE PROPOSED BY AAS

- ATS Layer (Airspace and ATS): Virtual Centres, made up of various ACCs with airspace allocated, provide geographically independent ATS and support Capacity on Demand by subscribing to real time data in the common data layer.
- Common Data Layer (ATM Data Services and Integration services): Effectively a set of Virtual Data Centres operated by ATM Data Service Providers, provides ACCs (and other stakeholders) access to all the relevant up-to-date data required for their operations which is processed from the raw auxiliary services data.
- Physical Layer (Auxiliary Services): Contains radio, radars and sensors which are geographically dependent to provide the raw data for the auxiliary services which can be rationalised.

The full provision of ANS across Europe will also include Network Management Services such as Flow Management and Transversal Services using System Wide Information Management (SWIM) and PENS (Pan-European Network Service).

Understanding the transition

Virtualisation of ATM is not simple and will not be achieved overnight. It is important therefore that a transition path exists with early benefits being realised whilst enabling the next steps and allowing different areas of Europe move at different paces.

Elaborating on the AAS proposal, in the short term **rationalisation** benefits are based largely on current technology, leading to additional benefits from greater **harmonisation** and eventually to **optimisation** including higher levels of automation. This section considers the potential benefits of each step in the three layers.

FIGURE 2: PROSED TRANSITION PATH

Step 1: Rationalise

The focus of first step is to use the principles of digitalisation to deliver benefits from the current generation of technology. This includes fully embracing SWIM for all operation data exchanges and developing a robust infrastructure for ground-ground communications as envisaged by NewPENS and the Single European Sky (SES) Digital Backbone. This supports benefits in the different layers:

- ATS layer: Increasing Air Traffic Control Officer (ATCO) productivity through the Operational Excellence Plan being developed by the Network Manager and initial steps towards capacity sharing between ACCs but only on predefined circumstances and usually within an ANSP or alliance.
- Common Data Layer: Potential rationalisation of ATM systems within the current paradigm.
- Physical Layer: Ability to rationalise Communications, Navigation and Surveillance (CNS) assets.

These benefits do not require virtualisation. However, the ANSP decision making process and subsequent organisational changes and motivation to achieve virtualisation provides an improved framework for general optimisation of ANS and accelerates non-virtualisation benefits.

Step 2: Harmonise

The focus of the second step to harmonise operational concepts to allow dynamic sharing of capacity between ACCs. This is enabled by a shift from sector-based validation to validation of the system. In the Common Data Layer there is a transition to ATM Data Services as a set of harmonised cloud-based services – reducing cost of service provision and system upgrades. Finally, additional CNS assets are consolidated due to the ability to plan coverage at a wider geographic scope.

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Step 3: Innovate

In this step, TBO is potentially ultimately realised and for any given gate to gate flight, all ACCs and Digital Towers are able to access the same flight data and propose resolutions to downstream conflicts early in the flight to avoid costly path stretching late in the flight.

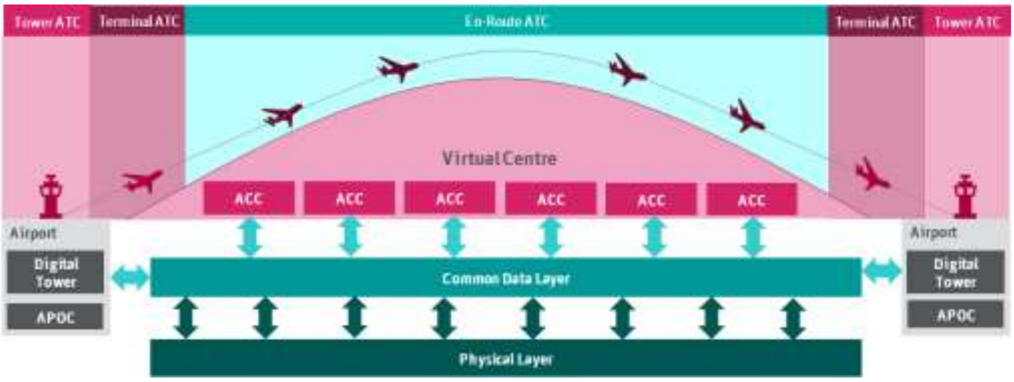

FIGURE 3: POTENTIAL FUTURE CONCEPT

This step uses the infrastructure established in step 2 to enable benefits in twofold:

a) Increased productivity and efficiency due to new ATM functionalities; and
b) Reduced costs of deploying those new functionalities compared to the current architecture.

These benefits exist at all three layers (although the ATCO productivity benefit is only realised in the ATS Layer). Step 3 is the realisation of the Digital European Sky.

Changes in the cost base

In 2018 the en-route ANS costs for the 30 States covered by the SES Performance Scheme in RP2 amounted to nearly € 6 billion – excluding AIS, MET and exceptional costs. The operating costs accounted for some 82% of total costs, and capital-related costs represented 18%. Costs were allocated to calculate the approximate market sizes for the layers:

- ATS layer has an approximate size of € 3,15 bn and an Operational Expenditure (OPEX)/Capital Expenditure (CAPEX) distribution of 91%/ 9%.
- Common Data layer has a size of € 1,15 bn and an OPEX/CAPEX distribution of 76%/ 24%.
- Physical layer has a size of € 1,7 bn and an OPEX/CAPEX distribution of 67%/ 33%.

However, since the national ANSP will retain overall ANS responsibility within a State, they will still need to collect revenues to cover the costs in all three layers and pay fees or subscriptions for any outsourced services.

As illustrated in Figure 4, if all Common Data and Physical Layer services were outsourced then CAPEX would be reduced from nearly 20% to just5% whilst the overall risk would remain largely unchanged. Given that the current Performance Scheme uses the Return on Asset Base (RAB) and weighted cost of capital to determine return in investment this would act as a barrier to virtualisation.

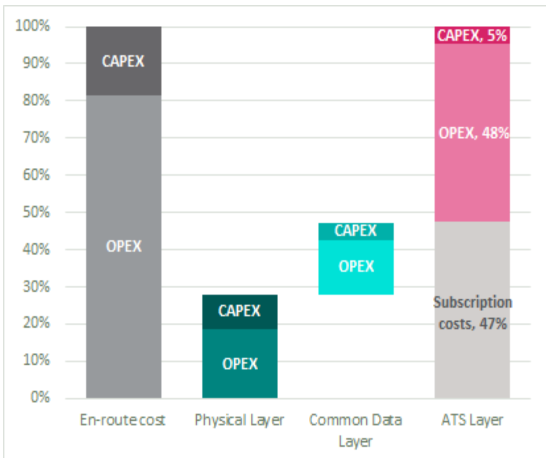

FIGURE 4: EXPENDITURE AND SUBSCRIPTION COSTS

The ATS Layer and its benefits

The ATS layer is the largest market with a size of €3,15 billion out of the total €6 billion en-route ATM/CNS costs.

The aim of the ATS layer is to enable cross centre collaboration leading to improved demand capacity balancing and increased scalability, resilience and reduced environmental impact. The proposed method is grouping ATS Units (ATSUs) into Virtual Centres (VC) to enables efficiency benefits from collaboration rather than consolidation of area control centres.

In order to be perceived operationally as a single centre with full collaboration, the following would be required:

- Handover between ACCs must be identical to handovers within an ACC;
- Controller Working Positions (CWPs) must be configurable to replicate any sector; and
- Either:
  - ATCOs being validated on a range of sectors across the full area of responsibility; or
  - Sector independent controller validations.

ATS layer benefits

The ATS layer cost savings come from three main benefits: increasing ATCO productivity, capacity sharing and contingency.

Increasing ATCO productivity

Increasing ATCO productivity potentially leads to lower cost as a result of being able to handle safely more traffic for a given period without introducing delays. This can happen in the short and in the long term:

- In the short term, ACCs can undertake a harmonisation process applying same operational concepts and ensuring interoperability. This reduces the operational and technical variations between ACCs that currently arise from different operational concepts, technology deployed and traffic complexity. All ACCs within a Virtual Centre can therefore achieve Operational Excellence and operate as best in class increasing ATCO productivity within the Virtual Centre scope.
- In the long term, virtualisation enables simpler and cheaper deployment of new ATM functionalities and services as a consequence of common interfaces, procedures and common data layer services. This, as envisaged in the deployment of SESAR Phase D – Delivering the Digital European Sky, leads to an high level of automation and at least 50% increase in ATCO productivity. Therefore automation leads to:
  - Lower cost of capacity – significant increases in ATCO productivity leading to reduced ATCO costs - but more importantly enable additional traffic to be handled without increasing ATCO costs.
  - Lower implementation costs – the costs of upgrading ATS layer systems to support high levels of automation may be lower, but the real cost reduction is in the common data layer.

Capacity sharing

Capacity sharing is the ability of ACCs in a VC to open sectors normally allocated to another ACC. This mitigates the current limited service quality, underutilisation of resources and delays that result from the traffic variability (and volatility), the limited flexibility and scalability that exist both across Europe and within ANSPs to adjust the capacity to the changing demand.

There are two forms of capacity sharing that can occur depending on the level of harmonisation of the Virtual Centre and of airspace redesign:

A) Limited capacity sharing – In the short term, enabled by a harmonised infrastructure and with the current airspace structure, capacity can be shared in pre-defined situations. En-route delays capacity related (11.7 million out of 17 million minutes in 2018) could be reduced if additional sectors could have been opened and this can be enabled by the Virtual Centre concept allowing ACCs with spare capacity to operate opened sectors in overloaded area. However, this is the benefit to the Airspace Users and it actually increases the ANSPs costs that comes with increasing the capacity where required. Furthermore, this benefit grows with traffic and next years unpredicted changes in demand as traffic levels recover.

B) Full capacity sharing – In the long term, to enable the "any sector, anywhere" concept, a high level of harmonisation and a complete airspace redesign is required to ensure common design principles, airspace optimisation and a harmonised operational concept that any ATCO can be validated on. This would provide ACCs the ability to handle additional traffic with a lower capacity buffer which is currently approximately 5-10% of an ANSP's capacity. That cost could be saved.

Contingency arrangements

In Europe, given the interdependence of adjacent airspaces, the knock-on effects of untimely loss of airspace capacity ripples around the network with disastrous effects. In case of an unexpected failure or disruptions, moving capacity into remote contingency centres (replicas of current ACC) can provide the required ATS services to support operations – but is a very expensive option especially if applied nationally.

Virtualisation, particularly once dynamic capacity sharing is established, enables a different way of planning system outages as the ATSUs within the Virtual Centre will provide a natural level of redundancy support contingency arrangements at short notice ensuring a smooth, safe, and quicker continuity of air traffic. The estimated benefits of improved contingency can be done in two ways:

- Delay avoidance – All the delays attributed to strikes and unplanned system outages bring cost to airspace users which could be avoided with effective contingency arrangements.
- Cost reduction – With virtualisation, contingency becomes part of the overall Virtual Centre rather than being a standalone cost of infrastructure (full equipped contingency centre) that no-one wants to use.

ATS layer full total cost savings

The overall cost savings of achieving in the ATS Layer could be up to €1.8 billion per annum (approximately 60% of the overall cost) depending on geographical scope as summarised in Figure 5.

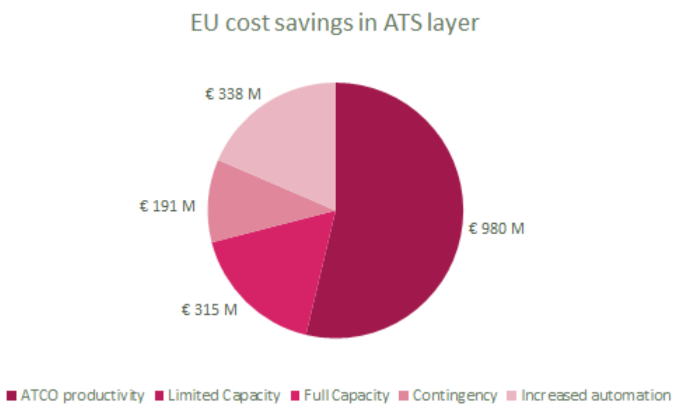

FIGURE 5: ATS LAYER BENEFITS

The Common Data Layer and its benefits

To maximise the benefits available in the ATS layer, the common data layer needs to ensure that ATSPs (and other stakeholders) are able to subscribe to data for all concerned airspace. This requires integration of all necessary data using an accessible and secure IT infrastructure so that any ANSP, airline or airports can access the data and collaboratively make the best decisions for individual flights and the network.

The common data layer provides two types of services:

- the ATM data services, which include flight correlation, conflict resolution, trajectory prediction, safety nets, conflict detection, arrival management planning, etc.
- and the integration of services (of raw data taken from the auxiliary services) weather, surveillance or aeronautical information.

The services of the Common Data Layer are provided by ATM Data Service Providers (ADSPs). ADSPs will operate systems to provide these services remotely from ATSPs (although an ADSP could be collocated with an ATSP). To the ATSP, the ADSP should appear as a virtual data centre. An individual ATSP may decide to subscribe to services from one or more ADSPs, but it is expected that ADSPs will collaborate to ensure data availability.

Common data layer benefits

The benefits of the common data layer are twofold. Firstly, as an enabler of the benefits in the ATS layer and to some extent the Physical Layer and secondly as a way of lowering the costs of providing ATM data services.

ATM SYSTEM RATIONALISATION

With the current architecture, each ACC has its own ATM system specially designed for the area of responsibility and operational concept. In the new architecture, rather than relying on the conventional data service at an ANSP level, ADSPs will offer the possibility of sharing the equipment and ATM system functions (e.g. FDP and or SDP infrastructure) between ANSPs as considered in projects such as ATM Data as a Service. Therefore the cost will be minimised but the savings do depend on the geographical scope the ANSPs decide to share systems in.

Through common procurement alliances such as COOPANS and iTEC, there is a move to a common platform for groups of ANSPs, but often with quite significant differences between installations. The lack of harmonisation therefore creates high costs for ATM systems. An analysis of TEN-T funding grants suggests that the cost of the next generation of ATM system may be up to 10 times higher – although to some extent this is also due to the greater level of functionality.

ATM DATA SERVICE HARMONISATION

The current generation of ATM system are designed around the airspace and operational concept of the ANSP. As noted above this creates a heterogenous systems with high development costs. The decoupling of the ATM data services from the ATS layer should allow for harmonisation – that is a common set of services provide to all ATSP in a harmonised manner, such that the ATSP is able to build in specialisation for specific local issues through different combinations of services. In this way the ATSP only needs to subscribe to the services required for their level of complexity.

Rather than consider rationalisation of ATM systems we consider that ATM data services would be provided by specialist providers operating infrastructure similar to current web-based services. That is the hardware is commercial products, but the software is ATM specific. Hence:

- ATSP get access to next generation of FDP services with a focus on interoperable high-performance cloud services (for example Coflight Cloud Services[1]).
- ADSPs operated by commercial IT providers and specialise in provision of data services with better quality and cheaper. These providers could follow a business model similar to Amazon Web Services[2].

ADVANCED ATM DATA SERVICES

Harmonised deployment has proved to be extremely difficult in ATM. There has never been sufficient motivation to align ANSP investments cycles. So, when a new ATM functionality is chosen for deployment, the national deployment plans have to consider the status of the ATM system, for some ANSPs the only way to implement the ATM functionality may be to purchase a new ATM system – which could be 10 to 15 years away.

The solution offered by virtualisation is that new advanced ATM data services would be deployed in the Common Data Layer, with the ATSPs able to tailor how they use the new services to maximise benefits. This approach is anticipated to be much quicker and cheaper than requiring harmonised upgrades to 55 FDPs.

Common data layer total cost savings

The overall cost savings in the Common Data Layer could be up to €420 million per annum (approximately 20% of the overall cost) depending on geographical scope as summarised in Figure 6.

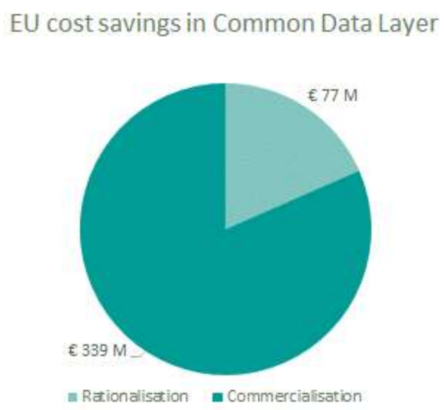

FIGURE 6: COMMON DATA LAYER BENEFITS

[1] https://coflight-cloud-services.com/
[2] https://cloud.google.com/

The Physical Layer and its benefits

The physical layer contains radio, radars and sensors which are geographically dependent to provide all the raw data from the auxiliary services (Communications, Navigation, Surveillance, MET and AIS).

Current arrangements for these services are based on the needs of the national ANSP and are often managed by the ANSP from the ATSUs. The current arrangements do include many data sharing arrangements (particularly for radar data) and pan-European providers.

The common data layer integrates this data into a single point of truth for every flight and enables auxiliary services to be operated independently from the ACCs enabling a more resilient and scalable system. Hence, the existence of a common data layer however increases the ease of benefits of such arrangements, and in particular would allow service provision over a greater geographical region and use of specialised providers to reduce costs.

By CNS we mean air-ground communications (voice and data), navigation and surveillance. Each plays an important role in ATM, and the national ATSP, who usually owns and operates the assets, is responsible for ensuring the CNS performance and coverage is consistent with the ATM operational concepts.

There have always been notable exceptions – particularly SITA for air-ground communications and ESSP[3] for EGNOS Navigation Services and more recently the advent of space-based ADS-B by Aireon[4]. These pan-European service providers point the way to the future integrated system, where a national ATSP is able to subscribe to a range of specialist services required to meet their CNS requirements (using the iCNS concept).

Physical layer benefits

In this section we consider the potential benefits in the physical layer, in terms of CNS rationalisation, consolidation and new deployments.

CNS Rationalisation

Currently, each ACC operates its own physical layer that includes CNS and MET sensors. In the context of traffic growth and a fragmented infrastructure based on a national basis, CNS showed over the years some inefficiencies, mostly related to an inappropriate distribution of equipment, saturated bands and overlapping operations of some technologies. The rationalisation of these services across the whole network is the first step and is key to an efficient and optimised system

In the new airspace architecture, the common data layer enables auxiliary services to be operated independently from the ACCs enabling a more resilient and scalable system. An independently use of operations is expected, that will serve all ATM data service providers. The aim is to rationalise the physical layer where possible, without losing coverage, resulting in an increased operational efficiency and cost savings.

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[3] https://www.essp-sas.eu/

[4] https://aireon.com/

CNS Consolidation

Under current arrangements, CNS asset planning has been performed by national ANSPs who define requirements based on achieving the necessary operational requirements. Nominally, the ANSP demonstrates the sufficiency of deployed CNS assets owned and operated by the ANSP supported by some data sharing with neighbouring ANSPs.

As virtualisation proceeds, in particular operational harmonisation, the CNS requirements will also be harmonised and the CNSP will use all assets they operate to demonstrate the required performance – hence allowing CNS planning at a wider geographic scope. This will minimise the operational impacts and harmonise the operations across border. Here collaboration between ANSPs is required, the focus being on data sharing and exchanges, to reduce certain assets and costs.

One area of specific concern is Secondary Surveillance Radar (SSR) as oversupply actually reduces the performance of the radars. According to the "Impact of fragmentation in European ATM/CNS, 2006" study, there were 203 primary radars, 300 secondary radars and 63 Mode S radars planned to be decommissioned.

CNS Deployment

The high levels of automation in the long term will require a refresh of the CNS infrastructure. The European ATM Master Plan includes the integrated CNS (iCNS) concept including proposed deployments of:

- Next generation air-ground data links (LDATS and satcom);
- Integrated surveillance; and
- Additional navigation infrastructure.

A coordinated and simplified implementation of new systems at European level will be enhanced, resulting in an increased system efficiency, high performance, and a significant reduction in costs. In the process, new approaches are looking on satellite-based technologies, datalink communications and new digital techniques, providing opportunities to rationalise services and maximise the rationalisation benefit.

Physical layer total cost savings

The overall cost savings in the Physical Layer ranges could be as high as €56 million per annum (approximately 3% of the overall costs) depending on geographical scope as summarised in Figure 7.

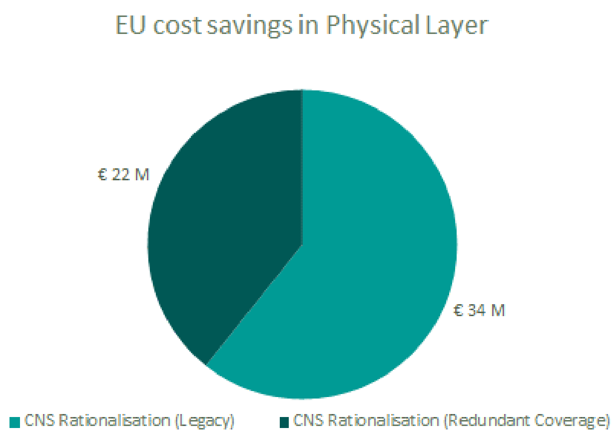

FIGURE 7: PHYSICAL LAYER SUMMARY OF BENEFITS

Market analysis

If virtualisation had been adopted before 2018 across Europe – ATM costs could have been 30% cheaper and en-route ATFM delay targets would have been met with only unremovable delay would have remained e.g. caused by weather. The potential net benefit to Airspace Users would have been in the order of €3.5 bn per annum by avoiding the cost of delays. These benefits are the maximum possible as a uniform application of virtualisation across the geographical scope is assumed and transition costs are excluded.

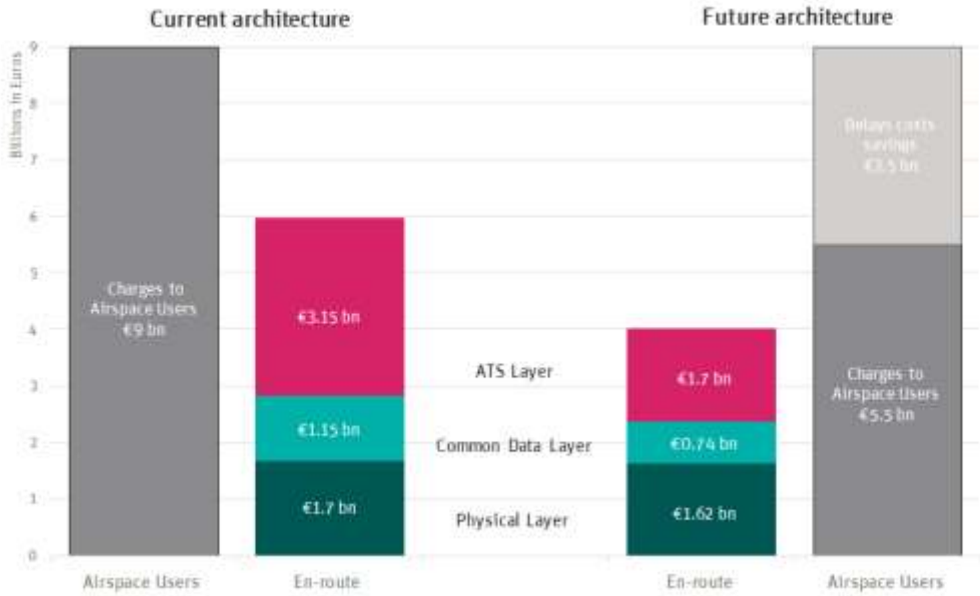

FIGURE 8: FUTURE COSTS OF ATM UNDER VIRTUALISATION

The real benefit of virtualisation is the reduction on the cost of capacity without significant increase in costs - up to 3 times the traffic could be handled without significant delay.

However, due to the current pandemic aviation has been severely curtailed and the quandary for the ATM industry is how to invest in modernisation when traffic (and therefore revenues) is lower. Justification is required to invest now in new infrastructure that increases flexibility and scalability to enable both increased capacity as required by airspace users and greater resilience to deal with future crises.

Current economic regulation is not suitable to deliver the future architecture. To incentivise the transition, either collaboration or competition could be deployed in each of the three AAS layers.

ATS Layer as a market

The ATS layer is the largest market and has the greatest scope for improvement with the potential to reduce current costs of about €3 bn by up to 60%.

Existing costs	Rational transformation of costs	Revised costs
€ 3,150 m OPEX: 90% CAPEX: 10%	Increased ATCO productivity enabled by Operational Excellence and increased automation. The reduced capacity buffer that the dynamic capacity sharing enables.	€ 1,660 m (50% reduction)

TABLE 1: ATS LAYER MARKET SUMMARY

In this layer, the benefits are incentivised by ATSPs collaborating to provide ATS whilst maintaining sovereignty. Collaboration encourages the behaviours to maximise the use of available capacity rather that organisational consolidation. However, competition could be applied to capacity and demand services operated by an EU body.

Common Data Layer as a market

Besides the benefits of the Common Data Layer itself, the flexibility provided to the ATS layer has three times the benefits available from rationalisation within the layer itself.

Existing Costs	Rational transformation of costs	Revised Costs
€ 1,150 m OPEX: 75% CAPEX: 25%	• Initial saving from rationalisation of infrastructure and systems. • Further saving from "commercialisation" of ATM data centres.	€ 740 m (35% reduction)

TABLE 2: COMMON DATA LAYER MARKET SUMMARY

A genuine common data layer (in which all authorised ATM actors can access all relevant information) could be achieved by a collaboration of ADSPs - potentially specialising in different types of ATM data service provision. Competition, which has been long in the European Commission plans, could lead to two models:

- Groups of ANSPs purchase an ANSP system for their entire area of responsibility.
- ANSPs subscribe to an ANSP system owned and operated by the system manufacturer.

Physical Layer as a market

The physical layer brings limited benefits within the traditional CNS markets but with higher potential when considering building the right network collaboration to successfully transition to iCNS and deploy new technologies.

Existing Costs	Rationale transformation of costs	Revised Costs
€ 1,680 m OPEX: 65% CAPEX: 35%	• The limited benefits in the physical layer from CNS rationalisation for legacy issues • Increased benefits when considering deployment of new technology.	€ 1,620 m (3% reduction)

TABLE 3: PHYSICAL LAYER MARKET SUMMARY

Collaboration in the physical layer has two potential benefits: improved CNS planning due to horizontal collaborations and reduced maintenance costs due to specialisation of service providers.

As a competitive market entry barriers would be high. However, a contestable market could be created by outsourcing operations and maintenance but not CNS planning and asset ownership which would be kept under the ANSP/State responsibility and therefore limit the horizontal collaboration benefit.

European procurement of commonly agreed new services by the Network Manager or another European body could minimize costs.

Incentivisation

During the course of Project RoMiAD, it has become clear that virtualisation offers an opportunity to modernise ATM in Europe by enabling collaboration between national ANSPs in a way not currently achieved within FABs. The virtual centre concept enables alliances of ANSPs to gain flexibility and scalability benefits previously only considered possible by consolidation of area control centre and even ANSPs.

It has also become clear that a greater understanding of the objectives of virtualisation is required to ensure that the technical solutions developed are capable of realising the benefits. Our analysis demonstrates that the real benefits (75% of the total) are through improvements in the ATS layer and that are best enabled by the flexibility that the common data layer provides. The focus needs to be on building alliance and collaborations within the ATS layer to ensure that the common data layer is able to support those collaborations.

The transition represents a technical challenge with new forms of standards and interoperability required. However, to achieve a successful technological change the real issue is in the organisational and regulatory sphere. This organisational transition cannot happen overnight and will need to go through different stages to get to its most optimum form, but we know from other industries such as telecommunications or banking that it is possible.

The initial decision a national ANSP faces is not the investment but the organisational model or the form of collaboration with neighbouring ANSPs in each of the three operational layers. Which in turn leads to questions on how best to incentivise "deeper" forms of collaboration.

Under the Single European Sky, ANSPs operate under a form of economic regulation that fixes unit prices for a reference period with return on investment tied to the regulated asset base. Traffic and risk sharing schemes reduce the risk to the service provider. ANSPs that operate in a contestable market are not subject to price control.

This form of economic regulation does not appear to incentivise the correct behaviours required to transition service delivery to the virtualisation model. Returns are based on capital employed which promotes ANSPs to increase planned capital expenditure (to increase allowed profitability) and to some degree to delay that expenditure (to increase actual profitability). An ANSP buying ATM data and CNS services will have lower CAPEX and higher OPEX (e.g. subscriptions to the underlying services) suggesting that switching to a TOTEX (total expenditure) approach may be more beneficial to successfully tackle the CAPEX bias challenge by providing greater scope for making efficient CAPEX-OPEX trade-offs, as proven by other industries.

Introducing competition in ATM should incentivise greater performance as entities strive to sustain and grow market power/share, resulting in downward pressure on prices and increased productivity. Competition tends to create a more cost-efficient and better-quality service, as entities are encouraged to shift to a more customer-centric approach in order to attain a better reputation than competitors. With virtualisation is possible to envisage competition in all three layers. However, to successfully introduce competition between firms contestability needs to be considered – low barriers to entry and limited sunk costs allowing new entities to easily exit.

Our analysis suggests that Common Data Layer would benefit from competion and to a lesser extent the Physical Layer, but in both cases a harmonised approach to outsourcing is required to ensure a coherent and contestable market.

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Glossary

ANSP	The certified provider of one of more Air Navigation Services (ANS). This is the regulatory definition of ANSP.
National ANSP	The organisation charged with the provision of ANS within a member state. This is the common usage meaning of ANSP.
Digitisation	The process of turning analogue signals into digital representations. Digitisation in ATM has been on-going for many decades but is not yet complete. Many voice-only ATCO instructions still exist, and key agreements such as the letters of agreement (LoA) between ACCs are not digitised.
Digitalisation	The transformative process of organisations taking advantage of digital technology. ATM is only scratching the surface of digitalisation. The AAS proposes one specific form.
Virtualisation	The specific form of digitalisation proposed by the AAS whereby organisational collaborations exist at the ATS, Common Data and Physical Layers mediated by digital infrastructure (and transversal services).
ATS Layer	The layer of the AAS where Air Traffic Services are provided.
ATSP/ATSU	ATS is provided by the ATSP from one or more ATS Units. ATSU can be ACC or terminal control (TC) or airport towers.
Common Data Layer	The layer of the AAS where ATM Data Service are provided. The Common Data Layer allows for greater interoperability and harmonisation by ensuing timely and accurate data is available to all stakeholders.
ATM Data Service	The services provided by ATM Data Service Providers (ADSPs) operating in the common data layer.
Integration Services	The integration services for Aeronautical Information Management (AIM), surveillance (SUR) and weather combine the geographically constrained scope of the underlying provision services in a service with a broader geographical coverage.
Virtual Centre	A collaboration of ATSUs in the ATS Layer. A Virtual Centre (VC) consumes services of ADSPs operating in a common data layer. Whilst the nature of the collaboration within the VC depends on organisational and technology choices, in theory a VC operates seamlessly as if it was one physical location.
Virtual Data Centre	A collaboration of one or more ADSPs to ensure data availability for all VCs served.
ATM System	The ATM system is the technical infrastructure within the current ATSU, traditionally comprising CWP, Flight Data Processing system (FDP), Surveillance Data Processing system (SDP), Voice Communication (and) Control System (VCCS) and numerous other systems that support the Air Traffic Controllers.

OUR EXPERTISE


Trajectory Based Operations


Remote and Digital Tower


Wake and Time Based Separation


Airport CDM


Performance Based Navigation


Flexible Use of Airspace


Unmanned Aerial Systems


Runway Optimisation


Virtual Centres


Enterprise and Airspace Architecture


ATCO Team Organisation & Training


Airspace Change


User Driven Prioritisation Process


Controller Tools


Sequencing Tools


Airport Safety Nets

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