White paper: Seamless migration

Moving towards the ATM networks of the future while maintaining today's quality of service

The clock is ticking for air navigation service providers (ANSPs), with a combination of factors making change inescapable. With new state-of-the-art technologies and air traffic management (ATM) concepts emerging, the spotlight is turned on the networks that enable providers to reliably and securely exchange information.

ANSPs face an important decision: adapt now and select the right solutions and partner to achieve maximum benefits from new technology, or wait until there is no other option and make changes without a clear direction and under pressure. In the safety-critical environments of the ATM industry, taking the time and investing the resources to carefully plan a risk-free transition to new technologies is the right choice.

In this paper, we will describe how Frequentis can use decades of experience and industry-leading solutions to help ANSPs realise the evolution to new networking technology to optimise outcomes, ensure compliance with a range of international ATM industry standards and enable exceptional service continuity, all via a low-risk, highly flexible, step-wise migration.

FREQUENTIS

Inevitability of change—embrace it, but keep control

For ANSPs, ensuring high-quality and continuously available services is essential to keeping passengers safe. In parallel, ANSPs must also balance the challenges of increasing air traffic and fulfilling compliance requirements, while minimising costs and complexity. A vital component in meeting these needs is ensuring the reliable exchange of information, which depends on selecting the right networking infrastructure.

Until a few years ago, TDM networks were the default choice for ATM voice communications and serial connectivity for ATM data. However, led by telecommunications providers, these legacy networks are now being phased out, and a migration to Voice over Internet Protocol (VoIP) and converged IP networks is in process. Organisations such as the International Civil Aviation Organization (ICAO), European Organisation for Civil Aviation Equipment (EUROCAE), Single European Sky ATM Research (SESAR) project and the NextGen program of the Federal Aviation Administration have defined guidelines around the transition to IP-based networks. In Europe, SESAR timelines anticipate that the transition to VoIP should be completed by 2020, the FAA has recently launched a TDM to IP initiative with the start of the roll out of VoIP-based ATC radios and many countries in Asia and Central and South America have also already embarked on a discontinuation of TDM and migration towards IP.

Recognising the benefits and addressing the challenges

The introduction of IP networks solves many of the issues that came with earlier generation TDM solutions. For example, TDM networks and legacy environments usually feature a strong dependency between single network backbones and individual applications, causing resources to be inefficiently utilised. Since all connections are based on point-to-point links between single components of the infrastructure, it is difficult to put contingency scenarios in place and the ability to share resources is limited. In addition, the utilisation rate of these dedicated links is often very low, resulting in a heavy cost burden for ANSPs.

In contrast, IP networks are packet-oriented, simplifying sharing of resources and the provision of contingency scenarios. This also leads to a better utilisation of the available bandwidth resulting in drastically lower recurring costs.

At the same time, because they are non-deterministic (unlike TDM networks) they present new challenges for which ANSPs may not be prepared. These include the introduction of variable delays and brown-out situations (where performance degrades rather than a link blacking out completely), and the adaptive nature of resource and bandwidth limitations. If networks fail or perform poorly, there is the potential for major impact on ATM service quality and availability, especially as the physical networks are typically not under the ANSP's control. Controllers may experience service disruption and poor audio quality, such as echo during radio calls to aircrafts, which increases their stress levels and lowers productivity.

Meeting the needs of today and tomorrow

Many ANSPs have invested in ATM equipment that interconnects using legacy network technology, which they expect to last for ten years or more. Abandoning these investments is not a cost-effective option, so to navigate the transition to IP networks, providers need technology solutions that support future network concepts and can integrate with legacy infrastructure seamlessly.

It is vital that air traffic controllers can continue working with minimal interruption or inconvenience throughout any transition period, otherwise airspace may need to be partially or temporarily closed. In this event, passenger safety may be put at risk, or there may be delays to their journeys, causing negative financial impact for all stakeholders. Consequently, the ideal migration scenario is one where the controller can continue working effectively and does not notice any difference—unless it is positive.

Seizing an opportunity

Many vendors offer IP migration concepts and tools, so the selection of the right partner is important when it comes to maximising the potential of new technology while safeguarding investments into existing systems.

By partnering with Frequentis, ANSPs face a unique opportunity. They can pre-empt the inevitable evolution to IP networks by adopting proven solutions and extensive expertise to ensure a seamless migration.

A typical solution proposed by other vendors is based on products that tunnel through IP networks, utilising proprietary technologies that require the same boxes at each end of the communication and do not comply with ATM standards. However, this approach only addresses the physical connectivity but does not consider the need, benefits and challenges at the network level, nor at the application/operational level specific to ATM industry. As a result, it represents a wasted opportunity, as it neither delivers benefits from the new technology nor solves the related challenges. It also requires over-provisioning of bandwidth to achieve the necessary accuracy and timings.

Figure 1: Building ATM-grade networks by introducing an SDN overlay – the vitalsphere concept

Brokering network capacity between ATM-specific applications and non-ATM specialised backbones. By increasing situational awareness, this architecture boosts safety and security.

3
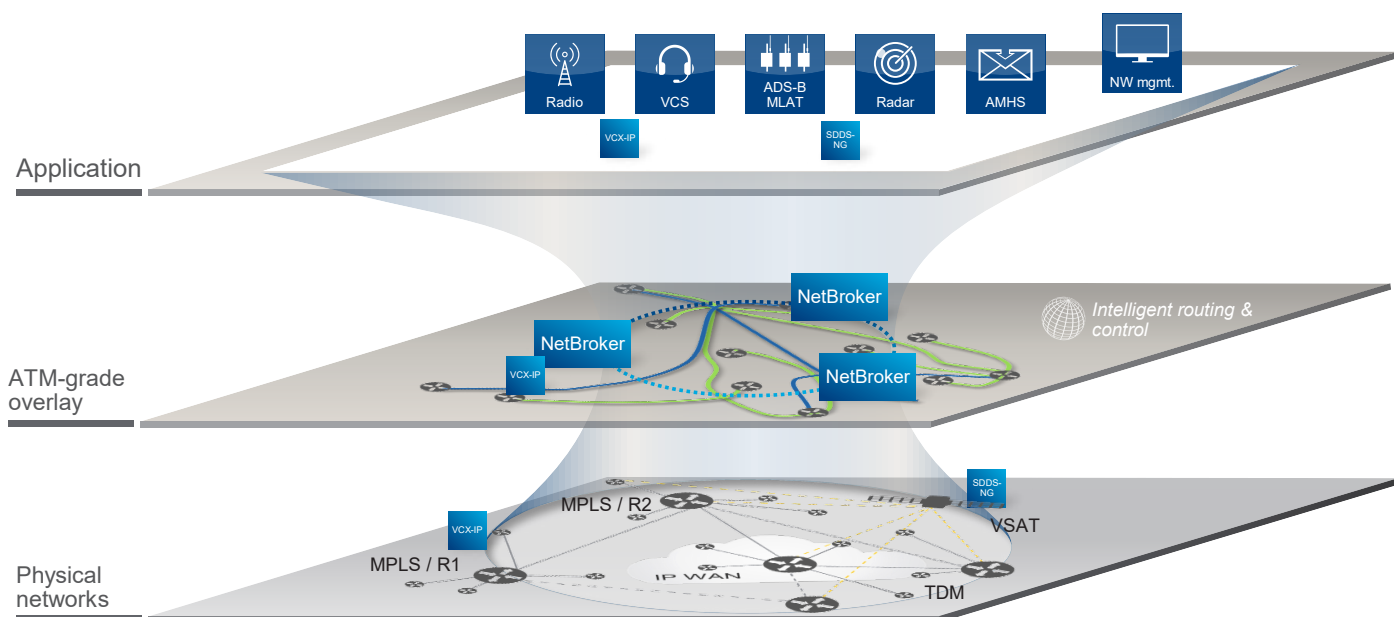
Equipment and infrastructure elements utilised in ATM and based on IP technology are required to comply with specific industry standards such as ED-137 to allow connectivity. COTS components that are not compliant with such a standard will not be able to connect to these components, and can only serve as temporary gateways to connect IP networks.

Vendors that do offer specialised gateways for voice and data communications lack the broad portfolio and experience that Frequentis can provide.

With Frequentis, ANSPs can get ahead of the game, gaining both the expert partnership and technology solutions required for a smooth transition. The next two sections describe how we can help to proactively mitigate emerging challenges, make full use of existing radar, voice and other equipment, and realise the benefits of new technology—all while securing ongoing operations during migration.

Low-risk migrations in action

Frequentis has already helped numerous organisations make the leap to IP networks successfully. This experience, coupled with a long and distinguished history of delivering ATM solutions, gives us the domain-specific expertise that enables ANSPs to achieve a seamless migration. The Frequentis experts have encountered all the usual use cases—as well as some less typical requirements.

When an ANSP engages Frequentis for a network modernisation project, we develop a comprehensive understanding of that organisation's specific needs, including operational procedures. One of the most important aspects is a clear view of the anticipated final state of the endeavour.

Next, providers can choose between three migration approaches, each offering different commercial and operational benefits:

- Purchasing an entirely new infrastructure, building it and then switching over in a single step. This approach is highly discouraged, since it invites unnecessary risk and such projects tend to have a high failure rate.

- Creating the new infrastructure in parallel, performing an incremental upgrade of the connected end systems, conducting thorough testing and making the switch – running the old solution alongside so it is possible to fall back to your original position until you have complete confidence.

- Taking a phased approach; modernising selected parts of the infrastructure and incrementally migrating applications to the new solution.

This final method appears the most complex, but involves the lowest risk. With unique experience in this area, Frequentis is the organisation that can help you achieve such a migration.

Gaining advantages with Frequentis technology

Frequentis solutions are designed to exploit the advantages of IP networks on multiple levels, overcoming the strong dependency between application and backbone that is the typical starting point.

They support ATM-specific interfaces such as ATS-QSIG, MFC-R2 and many more. Equally, the solutions incorporate industry standards, such as ED-137 for voice communications or ED-153/ED-109a for software quality compliance, satisfying ICAO and other regulatory bodies' rules.
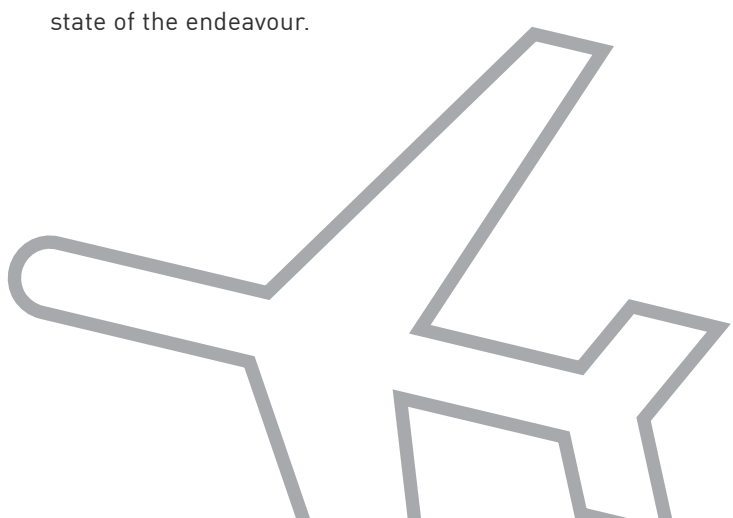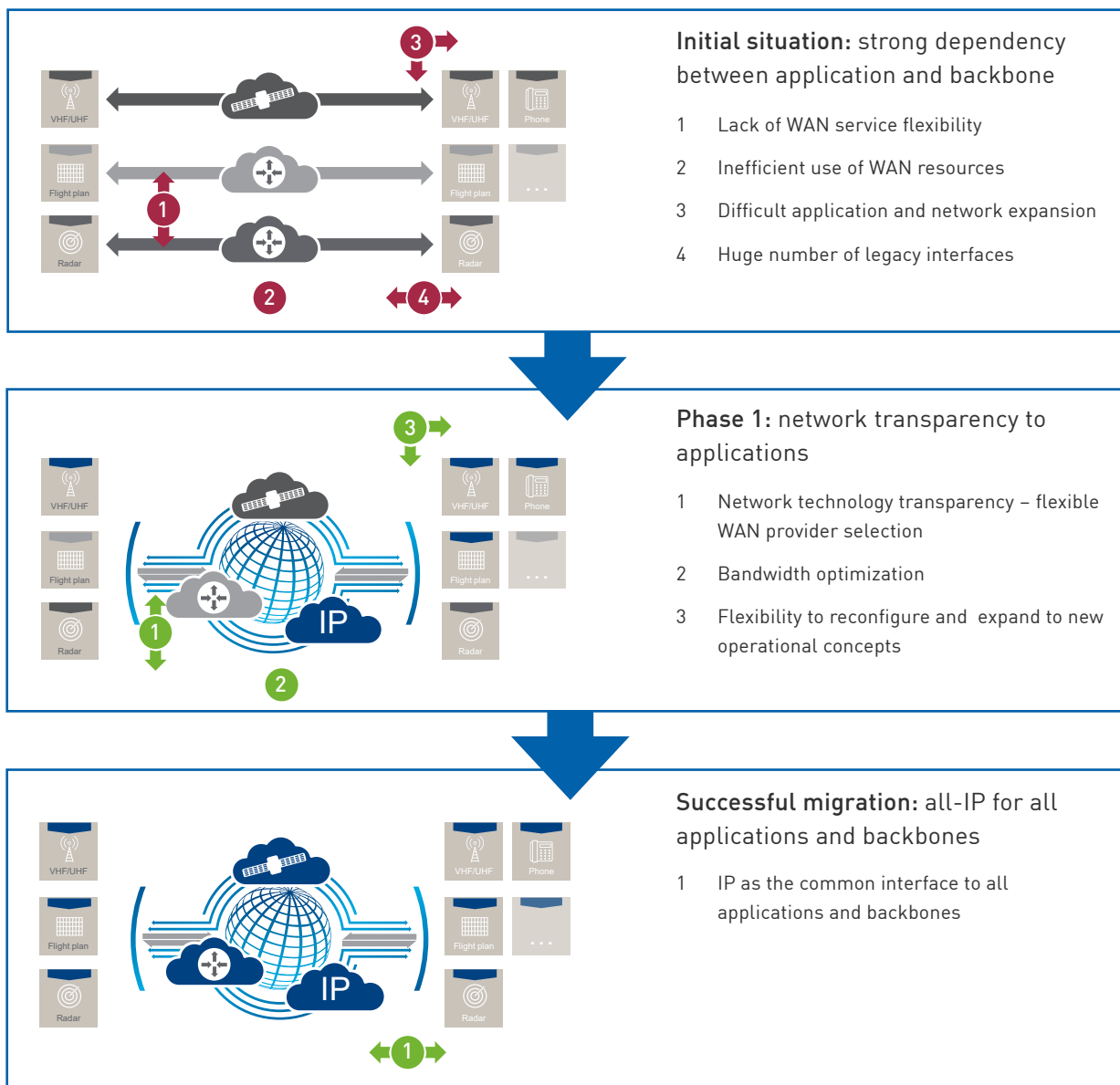
The technology is designed to ensure exceptional service continuity for controllers. For example, it optimises radio, telephone and data applications to deliver echo-free voice communications and mitigates the effects of delay, jitter and packet loss despite variable network delays.

Incorporating fully redundant hardware and software, solutions provide high availability and fast switchover in case of link failure, maintaining voice and data connections. End-to-end application performance monitoring ensures that brown-out scenarios are detected and the most critical application traffic is re-routed. These are examples of how Frequentis solutions help controllers exchange information safely and efficiently, an essential in the ATM industry.

Bandwidth is saved through methods such as geographical optimisation, which is realised through aggregation of multiple connections towards the same remote site to save on IP overhead and thus bandwidth, and use-case based optimisation, such as main/standby switching logic of the radios directly at the remote site and transparent for the controller. These, combined with ATM-specific bandwidth savings that go well beyond simple voice compression can deliver huge benefit—one ANSP achieved 90 percent savings.

Figure 2: Concealing network complexity from applications

Initial situation: strong dependency between application and backbone

1   Lack of WAN service flexibility

2   Inefficient use of WAN resources

3   Difficult application and network expansion

4   Huge number of legacy interfaces

Phase 1: network transparency to applications

1   Network technology transparency – flexible WAN provider selection

2   Bandwidth optimization

3   Flexibility to reconfigure and expand to new operational concepts

Successful migration: all-IP for all applications and backbones

1   IP as the common interface to all applications and backbones

In phase one of a migration strategy Frequentis typically enables network transparency to all applications, for flexible wide area network (WAN) provider selection. This is achieved by masking the complexity of management of multiple WAN types and vendors behind a transparent and homogeneous service.

Our solutions help ANSPs gain the flexibility to reconfigure and expand their infrastructure to encompass new operational concepts. In the next phase, ANSPs can work with Frequentis to make IP networks the common interface for all applications and backbones. Specifically, Frequentis offers ATM-specific, application-level gateways for voice and data communications (VCX-IP) as well as for Surveillance Data Distribution (SDDS-NG). VCX-IP and SDDS-NG are not just tools for the migration, but also deliver benefits for applications within a full IP environment.

The solutions support parallel usage of network technologies, so ANSPs can preserve TDM links, build up new IP connectivity and switch over each link when it is convenient and they have gained full confidence in the new infrastructure. They also enable the simultaneous use of legacy and IP technology for radio communications within a single frequency.

Enjoying the benefits

Engaging Frequentis to help with the transition to IP networks yields a range of benefits, summarised below:

- Simplify compliance with ATM industry standards, making it easier to ensure interoperability between legacy, new and future components.

- Maximise cost-efficiency by ensuring that you can fully utilise existing investments, deploying future-ready technology that integrates seamlessly with legacy equipment.

- Reduce risk through a step-wise migration, which you can build up in parallel with existing infrastructure or carry out on selected parts of the environment.

- Draw on Frequentis' industry-specific expertise to incorporate field-proven best practices into solution design and implementation.

- Mitigate the unfamiliar challenges of IP networks with solutions designed to compensate for their non-deterministic behaviour, eliminating echo and mitigating the effects of delay, jitter and packet loss.

- Enhance flexibility by rolling out an infrastructure where separate components can be changed without affecting overall operations.

Conclusion

The requirement to adopt IP is unavoidable due to changes in telecommunication providers' offerings and industry regulations, so it is up to ANSPs to make sure they are in control of their transformation. Teaming up with Frequentis for a cost-efficient, failsafe migration path is the lowest risk option, which enables you to build on the many successful transition projects completed or in process. In doing so, you can take advantage of the benefits offered by new technology and protect controllers from any negative effects of network changes, and ensure they have the tools they need to manage air traffic effectively. Act today to ensure that you can meet tomorrow's challenges that come with the migration to IP, and capitalise on its many advantages too.