CS8, the Pan European Network Services (PENS), aims at providing a unique, secure, cost-effective connectivity service using IP technologies for all ATM stakeholders in Europe. The main initial purpose of PENS is to be the sole infrastructure for cross-border connections supporting ATM operations in Europe including:

- the cross-border interconnection between all Air Traffic Service Units (ATSU) of civil ANSPs
- the extension to non-civil ANSP stakeholders, Airports, Aircraft operators and ATM manufacturers through secure and cost effective gateways
- all critical communication in support of the Centralised Services to enable their operations

CS8 will provide a comprehensive service management framework that will prove open to a wide spectrum of stakeholders and a wide range of technologies thus being in a position of becoming the means of ground communication supporting pan-European ATM operations.

The CS8 CONOPS details the service components, the roles and responsibilities of the main stakeholders as well as operational and architecture principles of the service.

Keywords

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EXECUTIVE SUMMARY

The implementation and operations of a reliable, performing and cost effective ground communication infrastructure is one of the key success factors for the ATM community in Europe.

Communications infrastructures supporting ATM services have to provide very specific service levels and meet very demanding performance criteria.

This is the reason why ATM stakeholders have implemented and operated dedicated specialised communications infrastructure to cope with the needs of ATM users.

The increasing focus on cost effectiveness, the introduction of next concepts and technologies (e.g. coming from the SESAR program) and the obsolescence of key legacy technologies have called for acceleration in the transformation of ATM communication services.

In 2009, EUROCONTROL and three major European ANSPs have triggered the transformation program by signing the PENS Contract, which now includes 18 ANSPs in Europe supporting ATM operations, both for these ANSPs and the Network Manager.

The PENS success, although showing the way ahead, did not yet allow reaping the full benefits of the evolution and remains an alternative in addition to existing legacy infrastructure.

The vision of PENS as part of the Centralised Services initiative aims at pushing further the transformation of ground ATM communications in Europe by providing a unique, secure, cost-effective connectivity service using IP technologies for all ATM stakeholders.

This service will not come as an addition to the current infrastructure since its ambition is to replace the entire legacy cross-border connectivity required to deliver ATM services.

In order to fulfil such an ambitious objective the current PENS construct will need to be further enhanced and adapted not only to cater for the most demanding requirements but also to deliver a service framework that will prove open to a wide spectrum of stakeholders and a wide range of technologies thus being in a position to cope with future ATM applications.

The Centralised Services initiative itself already demonstrates the need for such an endeavour and the limitation of the status quo.

The Centralised Service CS #8 - Pan European Network Service - aims at delivering such a framework service by capitalizing on the success of the current PENS contract but also by complementing it where the current has shown its limit in order to become the transport layer for all CS interconnectivity. It aims in particular at fulfilling very stringent performance criteria through an increased and direct control of the technical infrastructure as well as introducing innovative mechanisms to allow PENS to be open to all ATM stakeholders thus supporting all ATM communication needs.

In a nutshell, CS8 aims at taking PENS from being a means of communication for cross-border data and voice exchange in Europe to becoming the means of communication supporting pan-European ATM operations.
INTRODUCTION

Introduction by the Director General of EUROCONTROL

Following a request of the European Commission in November 2012, EUROCONTROL developed the concept of Centralised Services (CS).

Version 2.0, dated March 2013 of the EUROCONTROL Proposal for a first set of nine Centralised Services to contribute to SES Performance Achievement is attached as Annex 3. A short description of the proposed CS is attached as Annex 4.

The Agency proposed the CS concept in order to significantly support:

- the Member States and their ANSPs to reach or at least to come closer to the EU performance targets,
- the implementation of SESAR results on a central pan-European level
- the development of high tech solutions by European ATM manufacturers to be deployed on a central level providing the services to all ANSPs of the EUROCONTROL Member States,
- the creation of pan-European operational concepts for the Centralised Services proposed
- the creation of a pan-European market for these ANS support services
- the implementation of market mechanisms for some ANS support services through tendering of the services with time limited performance based contracts
- the creation of market opportunities for the ANSPs of EUROCONTROL Member States to provide services outside of their national boundaries, cooperating in newly founded consortia,
- the strengthening of the European Network, increasing capacity and safety,
- in the planning and execution phase much more user friendly 4 D trajectories throughout the European airspace

EUROCONTROL works closely with the Member States, ANSPs, civil and military airspace users, airports, the aerospace industry, professional organisations, intergovernmental organisations and the European institutions.

On 29 April 2013 EUROCONTROL invited the Airspace Users to participate in a workshop where the concept of Centralised Services was briefed. The Minutes of this Workshop are attached as Annex 5.

EUROCONTROL also invited the EUROCONTROL Member States on 4 March 2013, the ANSPs on 24 April 2013 and the ATM Manufacturing Industry on 17 May 2013 to demonstrate the Centralised Services concept. The minutes of these workshops are respectively attached as Annex 6, 7 and 8.

Following the PC/39 on 16 May 2013 and PCC/31 on 2 July 2013 EUROCONTROL updated on the CS concept. The working papers and slides presented as well as an extract from the Minutes of both meetings are respectively attached as Annex 9 and 10.

EUROCONTROL advisory groups such as AAB, NMB, MAB, CMIC, as well as EU bodies such as the SSC, ICB and its subgroups were briefed. These briefings were followed by so called CS specific workshops. This was a series of 9 workshops held in June and July 2013 -
for each proposed CS one specific workshop was held; CS 8 (PENS) workshop was held on 9 July 2013. The slides presented as well as the minutes of this meeting are attached as Annex 11.

The questions asked and answered in an intensive dialogue since the beginning of the program are publicly available. We like to refer to the FAQ list that is constantly updated and available on the EUROCONTROL homepage.

The CBA figures presented in detail for all the 9 CS support the initial assessment done, that a 150 to 200 million € cost reduction for the airspace users is possible through the implementation of the 9 centralised services proposed by EUROCONTROL. Specific focus was put on the synergy effects foreseen between the different centralised services.

It was agreed with the stakeholders, that the Agency would invite the participants to the individual CS workshops, as well as the existing EUROCONTROL advisory groups to participate in specific meetings in September and October 2013 to develop a pan-European ops concept for each of the Centralised Services.

This draft ops concept has been prepared for the presentation and discussion with all interested stakeholders at the Ops Concept Workshop for CS 8 (PENS), which will be held on 31 October 2013.

The Ops Concept will be used by EUROCONTROL to develop requirements to be part of a Call for Interest and a Call for Tender for CS 8 (PENS). All proposed Centralised Services will be operated under performance based contracts by a Service Provider on behalf of EUROCONTROL.

Our partners are involved at every level of the corporate governance structure. The deployment and operation of CS will impact the remit of the Network Manager. Therefore, its governing body, i.e. the Network Management Board where the EC, EUROCONTROL, ANSPs, airspace user, airports and the military are represented could be extended in the future, the operation of the CS being supervised by EASA; the latter is already supporting the European Commission in the oversight of the Network Manager. Through its nomination as Network Manager, EUROCONTROL will be entrusted to manage the centralised services.

Frank Brenner
Director General of EUROCONTROL
October 2013
CHAPTER 1 – Context

1.1 Geographical applicability

The intended geographical coverage of CS8 - PENS is the ICAO EUR/NAT Region and the non-ECAC bordering States.

1.2 Aim

Air Traffic Management (ATM) stakeholders across Europe depend on communications infrastructures to support their operations.

These communications services include a wide range of technologies and service levels to cater for their different needs, be it from an availability, performance or cost standpoint.

Although a large part of the communications needs are limited to national borders, international communications is a key component to support an efficient ATM network.

Most international connections result from bilateral agreements between national stakeholders and thus follow a point-to-point topology between both parties.

Many communication infrastructures also still rely on obsolete technologies and protocols such as X.25, analogue leased lines, 2 Mb/s TDM connections.

In 2009, three European ANSPs, together with EUROCONTROL, signed the PENS contract (referred to as PENS 1 in the rest of the document) with SITA implementing a pan-European IP network to support ATM operations in Europe.

At the beginning of 2013, PENS 1 reached a total number of 18 PENS Users covering most of the European airspace.

Despite this successful ramp-up and the validation that PENS 1 was fit for purpose to support the operational communications of ANSPs, the actual use of PENS 1 for operational purposes by the ANSPs is still limited.

Additionally the PENS 1 construct with its current governance has proven cumbersome to accommodate the interconnection with non-ANSP stakeholders.

The concepts coming out the of the SESAR program (as part of SWIM in particular) make it clear that seamless communication between all European ATM stakeholders such as ANSPs, Airlines, Airports, both civil and military will be a key requirement in the years to come. CS8 will fulfil these requirements, by delivering the next generation of the PENS service. Additionally, providing access to the service for the ATM manufacturing industry will be a significant asset to support SESAR and future research activities.

The main purpose of CS8 is to capitalize on the developments and the achievements of PENS 1 to fully reap the benefits of implementing a single IP network for all ATM stakeholders in Europe.

The main business objectives of CS8 are:
• Offer a single ATM-grade IP network for all ATM stakeholders replacing all cross-border connections
• Accommodate for a wide range of service levels and access technologies to offer a safe, secure and cost effective solution for the deployment of ICAO standardised ATM IP based applications.
• Support both voice and data based applications
• Be the communication backbone for all other Centralised Services that will require specific communications services
• Provide network architecture expertise, operational monitoring and management services to ATM stakeholders that would require it
• Position itself as the SWIM backbone and ensure full compliance with the SESAR concepts

For illustration purposes and in order to provide a reference to the current PENS 1 setup, the scope of CS8 will be the following:

Note for military organisations: Centralised Services will contribute to civil-military interoperability and will offer significant benefits to military users while respecting the national roles and responsibilities, the specific governance and management processes in place and information ownership, control and security requirements applicable in military context. Improved services will focus on existing information exchanges complementing arrangements with local ANSPs.
1.3 Intended Audience

The intended audience is the CS8 CONOPS workshop participants and all the stakeholders who are interested in the development of CS8. The document will also be used to define the operational requirements for the Call-for-Tenders for the Centralised Service on Pan European Network Services (PENS). Once the European actors have developed the operational concept, it is envisaged that the CS8 CONOPS will be presented by EUROCONTROL as the recognized organisation to ICAO and subsequently be discussed in the framework of ICAO, to achieve a common communications infrastructure strategy at a global level with the aim to integrate the ideas into the ICAO provisions.

1.4 Intended Benefits

CS8 provides a wide range of benefits to the European ANSPs but also to the non-ANSP ATM stakeholders in Europe.

1.4.1 For European ANSPs

In the short term, PENS will provide significant cost efficiencies compared to the legacy, dedicated, bilateral international connections between ANSPs in Europe.

Additionally, it will reduce the effort for individual ANSPs to migrate ATM applications to IP by offering a ‘ready-to-use’ infrastructure compliant with the ATM standards.

Finally, PENS will reduce the coordination effort between ANSPs to validate, test and transition ATM applications since such initiatives will be based on a common shared infrastructure with agreed processes and procedures and no longer on dedicated connections.

PENS will provide cost and effort efficiencies to implement new IP applications and services (e.g. SESAR developments) by delivering an infrastructure compliant with upcoming concepts and services (e.g. SWIM).

Overall, PENS provides a future-proof ground communication infrastructure for all ATM stakeholders in Europe and is a required enabler supporting SESAR and its implementation in the years to come.

1.4.2 Beyond European civil ANSPs

One of the key business objectives of PENS is also to offer a simple and secure way for other ATM stakeholders than the European civil ANSPs to connect to the ATM ground communication infrastructure.

In particular PENS will cater for the communication requirements coming from military ANSPs but also Aircraft Operators and Airports to be able to connect to ATM applications through dedicated gateways developed within the PENS initiative.

Finally, to ensure a proper rollout of SESAR developments and other Research initiatives, PENS will provide an infrastructure framework for ATM manufacturers to communicate with ATM stakeholders.

1.4.3 For the Network Manager

Due to its central role and position within the ATM community the Network Manager will heavily rely on the PENS services to support its operations during the transition to full CS
implementation, and for the Centralised Services for which CS8 will provide a cost efficient and reliable infrastructure for critical information exchange.
CHAPTER 2 – Operational Concept

2.1 Scope

The scope of CS8 includes all cross-border communication needs between Air Traffic Service Unit (ATSU) of ANSPs in Europe as well as the communication needs of the Network Manager for its current operations in a transition phase towards full operation of the Centralised Services.

CS8 will be delivered to relevant delivery points in order to efficiently support the operations of the users of the Service. Such delivery points will include the European Air Traffic Service Unit (ATSU) and the service delivery points of the Centralised Services.

Moreover, CS8 will include a set of dedicated gateways to support interactions with military, airport, ATM industry, aircraft manufacturers, and aircraft operator stakeholders preferably through a network-to-network interconnection rather than reaching individual stakeholders.

CS8 will also include a comprehensive service management framework to ensure the provision, delivery and support of the PENS services at the required levels of service.

2.2 Components / CS8 Portfolio

The purpose of CS8 is to offer a safe, secure, robust and cost effective (IP) transport service between all ATM stakeholders.

The CS8 Portfolio will include:

- different logical stacks from the access layer to connect to the core network,
- a set of IP connectivity services to support the different type of IP communication flows required by ATM stakeholders,
- a specific set of services to secure and encrypt IP flows,
- the setup and management of network-to-network gateways,
- network consulting services to support CS8 users in migrating their applications to IP.

Different service levels will be available, at different cost levels, to cater for the wide range of requirements coming from the various CS.

2.2.1 Access-layer Circuits

The access layer (access circuits) to the PENS network will include a large spectrum of options ranging from E1 circuits (2 Mb/s) to metro-Ethernet connections (up to 1 Gb/s) but also tunnelling over the Public Internet depending on the service requirements of the PENS users.
The types of access circuits available in the CS8 service catalogue will evolve, reflecting at all time the standard offering of the telecommunication market.

The access point will foresee – where appropriate and beyond the access circuit itself – standalone access infrastructure per type of traffic (operations, test, R&D) and/or per group of ATM applications (messaging, surveillance). The objective being to reduce the complexity of the release management activities that currently exists on PENS 1.

In other words, although the access circuits (physical cable) are shared between all users of a given location, the active components (e.g. Customer Premise Equipment or CPE) might be dedicated for specific traffic in order to further increase the robustness when needed.

2.2.2 IP connectivity

IP connectivity is the core service of the CS8 portfolio.

IP connectivity will be available in different flavours depending on the required protocol (IP version 4 or IP version 6) but also the different topology (unicast or multicast).

Other protocols and services such as a Network Time Protocol (NTP) service for the synchronization of clocks or a Domain Name System (DNS) service will be offered as well.

2.2.3 Secured IP flow

On top of providing basic IP transport, CS8 will include the option to benefit from a secured encrypted data flow for those users / applications that would require an extra level of data confidentiality, integrity, authentication and non-repudiation.

This feature will ensure data confidentiality between users, but also with the Service Provider.

2.2.4 Gateways

CS8 will ensure connection to non-ANSP stakeholders by defining inter-network gateways.

2.2.4.1 Air / Ground (A/G) CSP Gateway

As described in 2.5.1.7, CS8 will offer a means of interconnection with CS9, the A/G Communications Service Provider (CSP) networks thus allowing ANSPs to avoid setting up dedicated connectivity towards the CSPs.

2.2.4.2 Military Gateway

A specific gateway will be developed to address the CS8-military interoperability requirements. When the national military organisations decide to subscribe such services, it will enable the interconnection between PENS and military ATM and/or Air Defence systems to exchange relevant information with civil ATM domains and other CS (e.g. aeronautical information, surveillance, flight data, ASM, etc.).

Military access to PENS can be provided either locally (via the ANSP network) or by a dedicated router/gateway. In this case, CS8 will allow individual military subscribers to access services through direct connections (e.g. military ANSPs connecting to CS5 or CS4).

A PENS-military gateway will address the NATO Air Command and Control System (ACCS) interoperability shortcomings; the technical coordination between EUROCONTROL and NATO on that topic is currently underway.

2.2.4.3 Airspace Users Gateway

The Airspace User (AU) Gateway service will allow an ATM stakeholder connected to PENS (i.e. ANPS, NM, etc.) to exchange flight information messages with aircraft operators using Type B or Type X messages.
2.2.4.4 Public Internet Gateway

CS8 will provide a Public Internet secured interconnection relying on a Public Internet Gateway.

CS8 being the communication infrastructure supporting the operations of the Centralised Services, it will include the possibility for the CS locations hosting the various CS databases to be accessible via the Public Internet.

This service will be provided over a dedicated infrastructure to ensure a complete isolation with the ATM operations and thus prevent any security issues.

This item will also be subject to a detailed impact study during Phase 1 of the CS8 Project to ensure it will not increase security risks on ATM Operations and to confirm the need for such an access over the Public Internet.

2.3 Technical Architecture Principles

2.3.1 Access Layer

CS8 will offer a wide range of access technologies to cover a large spectrum of bandwidth requirements but also to be in a position to offer the requested level of availability for every remote location.

For those users that will request it, PENS will provide two physically separate access links with no single point of failure (SPOF) to connect to CS8.

Contractual requirements on the PENS Service Provider and regular audits will enforce/verify redundancy and SPOF avoidance at access layer (physical or logical SPOF).

2.3.2 Dual Core Approach

In addition to providing full redundancy and SPOF avoidance at the access, PENS will be built around two separate core networks based on two technically independent infrastructures.

For those applications requiring it, each of the access links will thus connect to a different PENS core to ensure that a massive core disruption will not impact the overall end-to-end connectivity. Consequently, even the most demanding applications (such as real-time traffic, voice or the exchange of surveillance data) will be able to rely on CS8 to fulfil their communication requirements be it for performance, capacity, availability or Quality of Service.

2.3.3 Integration Layer

Because of the 2.3.2, an integration layer will be required to offer a seamless service to the CS8 users.

The integration layer will ensure that all operational processes be performed seamlessly over the overall infrastructure.

Such integration will ensure that the different telecom operators providing the access layers (physical circuits) or the different IP connectivity services (network core) remain hidden from the CS8 users for all aspects related to the delivery of the CS8 services.

Additionally, the integration layer could ensure that key assets of the PENS infrastructure such as the Customer Premise Equipment (CPE) or the assets supporting the PTC and POC functions (see below) would be provisioned, managed and retained independently from the network service providers or telecom operators.
This construct would in particular ease the transition from one service provider to another and thus avoid vendor lock-in to a large extent.

2.3.4 Quality and performance requirements

In order to meet the requirements of ATM stakeholders, CS8 will provide guaranteed quality and performance indicators (KPI or Key Performance Indicators).

The availability KPI will establish the committed level of availability of CS8 for each user. This level will vary from user to user, location to location and application to application. The most stringent level of availability will ensure that service disruptions will not exceed a few seconds on a daily basis.

The round trip delay KPI will set the maximum transit time for an information item (IP packet) to cross the PENS network and come back to its origin. Such an indicator is key for real-time application such as voice communications but also for time-sensitive surveillance data. Depending on the service the round trip delay is expected not to exceed a few dozens of milliseconds.

The jitter KPI is linked to the round trip delay and expresses the predictability or regularity of the round trip delay. This parameter is key for voice communications where delay is important but delay variations can also heavily impact the perceived voice quality. Jitter is expected to be a fraction of the round trip delay value not to impact the most critical services.

The packet loss KPI will establish the reliability of the PENS network in delivering an information item once is has been sent. Although other technical layers (such as the application itself) could cater for the loss of information over the network ensuring a very low packet loss value (i.e. fraction of a per cent) is a key expectation of CS8.

Naturally, on top of the technical KPIs listed above the CS8 service framework will include a full list of indicators to measure and control the quality of all the service processes, from the number of rings before the service desk picks up the phone up to the number of errors in the invoice.

Such a performance-driven framework will greatly benefit from the one defined for the current PENS 1 contract but also from other similar IT contracts within NM.

2.4 Operations

CS8 will offer a comprehensive service management framework to ensure the provision, delivery, monitoring and support of the PENS services at the required performance level.

The PENS service management framework will notably include the following functions and processes.

2.4.1 PTC - PENS Technology Centre

The PTC aims at introducing an engineering / technical centre responsible for the engineering and technical design of the CS8, and for supporting CS8 users with technical network expertise for their connectivity needs.

The PENS Technology Centre will be performing its tasks during business hours; however key technical experts from the PTC will be involved as Level 3 support during incident on an ad-hoc basis (on-call mechanism).

The main tasks of the PENS Technology Centre will be:

- Defining architecture and design standards to ensure that enterprise-level communications services available from telecom vendors across Europe are adapted
and improved to support ATM applications. This will allow PENS to benefit from the managed service approach but also to remain in line with the expectation of the ATM stakeholders.

- Defining the PENS architecture roadmap to have the PENS benefit from technological evolutions in a controlled and efficient manner. Although PENS is designed to cater for the ATM applications of today, upcoming SESAR-related developments will require the PENS service to keep on evolving and adapting from a technology, coverage or performance standpoint. The PENS architecture roadmap will offer a technological vision to fulfil that purpose and share it with the ATM community.

- To complement the design and technology roadmap activities the PENS Technology Centre will setup, maintain and operate a PENS Lab to ensure that technological evolutions or new features are introduced on the PENS infrastructure in a controlled manner. This activity will come on top of the standard validation process performed by telecom vendors and will ensure that the PENS infrastructure is protected from uncontrolled changes.

- As mentioned above, the PTC will also provide Level 3 support to the PENS Operations Centre on an ad-hoc basis. This support will be required for complex incidents where technical issues cannot be solved by the PENS Operations Centre or the telecom vendors on their own.

The PTC function was not clearly identified in the PENS 1 contractual setup, its introduction and formalization has been triggered by the need to have a closer follow-up on the technical evolutions and the individual features introduced by the PENS Network Service Provider and the telecom vendors.

Following the delivery of the PENS 1 contract it became clear that the managed service approach is a viable option to support ATM services provided the user community could establish a very tight control on the technical, process and even organisation of the different parties delivering the service.

Such a control and management will be greatly helped by the introduction of the PTC, which will allow PENS to align with ATM-grade expectations.

The Network Service Provider of the PENS 1 Contract currently performs a limited set of the activities of the PENS Technology Centre in a less formalized manner together with the ad-hoc support of the technical and engineering IT network teams of DNM/NTS and some ANSPs. These activities will be formalised as described above and conducted by the CS8 Service Provider.

2.4.2 POC - PENS Operations Centre

The POC will be an operational centre (Level 1 and Level 2 support) responsible for the daily operations of CS8 including 24/7 supervision and monitoring for network and security issues.

The POC will be the single point of contact for all incident and event reporting and will interact with CS8 users in order to resolve any service disruption in the shortest possible time period, limit the impact and avoid reoccurrence.

Over the past years (with the PENS 1 contract and its predecessor the MINS contract supporting only NM services) daily operations including a 24/7 service desk were fully entrusted to the network service providers.

This led to a lack of effectiveness and ATM knowledge of such a key link in the support chain, which was in some instances not even dedicated to the service or the user community.
The introduction of a dedicated and ATM knowledgeable PENS Operation Centre (POC) will greatly increase the confidence of ATM stakeholders when migrating their operational traffic to PENS.

The Network Service Provider of the PENS 1 Contract through the PENS Service Desk currently performs most of the activities of the PENS Operations Centre (POC) with the support of the Network Operations Centre (NOC) or Network Management Centre (NMC) of each ANSP and the EUROCONTROL DNM/CSO support organization together with the DNM/NTS/CNS/IOS section for Level 2 support.

As the PENS Technical Centre (PTC), the PENS Operations Centre (POC) service will be entrusted to the CS8 Service Provider.

2.4.3 CS8 Process Framework

In addition to the technological layer (technology) and the organizational aspects (people) of the PENS services, the initiative will be complemented by a comprehensive process framework (processes) which will result a key asset for the CS8 users.

2.4.3.1 Incident / Problem Management

Incident and problem management processes will be established (including escalation paths) to ensure a swift and efficient resolution of service disruptive events including the necessary coordination with the operations cells of ATM stakeholders. The key actors in the Incident and Problem Management processes will be the POC (PENS Operations Centre), the CS8 Telecom Service Provider(s) and the support organizations of the each CS8 user.

2.4.3.2 Change Management

Change management on the PENS backbone will be under the supervision the EUROCONTROL PENS Management Unit (PMU) in order to guarantee the consistency and integrity of the PENS communication backbone.

The PMU will ensure that a proper impact assessment will be conducted and communicated before a change is being release onto the infrastructure.

Any request for change will require formal approval of the PENS Management Unit before it is passed to release management for implementation. Performing changes (and releasing them onto the infrastructure) in a controlled manner is a key element of the quality of service of the PENS infrastructure.

2.4.3.3 Release Management

The PENS Operations Centre, under the control of the PENS Management Unit, will coordinate release management including post-implementation review of changes.

Release Management covers the actual implementation of a change on the infrastructure and remains one of the riskier activities that could lead to service disruptions. The experience gathered from the PENS 1 contract will be taken in to feed the establishment of the Release Management process under the control of the PENS Operations Centre (POC).

Change Control and efficient communication and coordination with stakeholders around planned interventions will be instrumental in reducing risks and preventing service disruptions.

2.4.3.4 Monitoring and Supervision

All PENS assets will be monitored 24/7 by the PENS Operations Centre (POC).

A view of the supervision and monitoring status will be made available to ensure
transparency of the PENS operation to all stakeholders.

2.4.3.5 Availability Management
Periodic audit at layer 1 (physical), layer 2 (connectivity) and layer 3 (routing) will be performed in order to ensure the absence of single point of failure whether at PENS access points or within the network itself.

2.4.3.6 Capacity Management
CS8 capacity will be monitored to ensure a proper alignment of the capacity provided with the user demand. Conclusions coming from the capacity management reports shared with the relevant users of the service.

2.4.3.7 Service Levels
As detailed in 2.3.4, CS8 will offer a wide range of service levels, at different cost levels, expressed via technical key performance indicators (KPIs) such as:

- Integrity
- Availability
- Round-trip delay
- Packet loss
- Jitter
- Capacity

KPIs will be monitored and reported upon on a regular basis.
Incentives will be put in place to ensure that the KPI targets are met.

2.4.3.8 Reporting
Reporting on the following items will be made available to the CS8 users:

- Service Utilisation providing statistical information related to the actual use of the infrastructure (% average load, % peak load)
- Service levels to report on the service level KPIs listed above
- Service performance to report specific technical items which might not be subject to a service level commitment from the CS8 Service Provider but which could be of interest for the PENS users
- Incidents and service disruptions to provide full transparency on the incidents and service disruptions and thus feed the Problem Management process, which is looking at trends and repetitive incidents (occurrences)
- Changes to provide statistical information on the efficiency and effectiveness of the change management process as well as indicative trends of the CS8 evolution
- Redundancy and single points of failure since this specific item of the infrastructure robustness has proven to be a key element in the service quality and should thus benefit from a specific dedicated scrutiny and reporting.
2.5 Roles and responsibilities

2.5.1 CS8 Users

CS8 will connect wide range of ATM Stakeholders and support their communications requirements. These communications flows might be between ATM stakeholders (e.g. two ANSPs exchanging flight data or voice communications) but also between remote locations of NM Centralised Services and the CS Datacentres.

2.5.1.1 Civil Air Navigation Service Providers (ANSPs)

ANSPs will be connected to CS8 for different purposes.

Firstly to provide an end-to-end service supporting all cross-border inter-ATSU (Air Traffic Services Unit) communications including support for the following Air Traffic Services (ATS) applications:

- AMHS flows for the exchange of aeronautical information such as flight plans
- FMTP flows for the exchange of coordination and transfer messages (On-Line Data Exchange - OLDI)
- Surveillance flows for the exchange of radar/surveillance data between ANSPs
- Voice over IP communications to support voice communications between adjacent Air Control Centres (ACCs) needed

Additionally, PENS will interconnect existing domestic IP network (where relevant) to support all traffic flows above from their ATS Units with other ANSPs ATS Units. This means that although CS8 aims at interconnecting directly all ATSU across Europe, it might rely on
existing infrastructure elements provided that required service levels, technologies, processes and organisational expectations would be fulfilled.

In addition to meeting the needs of cross-border inter-ATSU communication, CS8 will allow ANSPs to connect to centralised resources such as the Centralised Services but also, in the transition period, to the current services provided by NM.

CS8 will ensure the business continuity for the services provided today by the Network Manager and which rely on the connectivity between remote locations (Flow Management Positions within ACC or Aeronautical Information Services) and the central datacentres (either within the NM premises or elsewhere).

These services include in particular, the support of Flow Management Services provided via the CHMI application and the NOP Portal, the EAD service but also the exchange of trajectory information through the ETFMS Entry Nodes and the AFTN / AMHS network (using the PENS infrastructure) to distribute validated flight plans to ANSP ACCs across Europe.

Once the CS are deployed, ANSP locations will rely on CS8, to connect to the NM Centralised Services datacentres. The topology, technology and service levels required for this service layer will highly depend on the business requirements coming from each and every Centralised Service.

The identification of all the technical requirements related to the support of the CS communications will be included in Phase 1 of the CS8 project in cooperation with the other CS projects.

With the introduction of the network-to-network gateways (see 2.2.4), ANSPs will also benefit from a simple, secure and cost effective means to connection to reach non-ANSP stakeholders such as:

- Connection Air / Ground Communication Service Providers (CSP) over CS8 thus replacing the ad-hoc dedicated connectivity infrastructure currently in place
- Connection with military users (including military ATM and C2/Air Defence systems interconnection gateway)
- Connection to a central messaging gateway to exchange flight information with Aircraft Operators / Airlines (e.g. TypeB / TypeX messaging services)
- Connection to a central internet gateway to offer secure internet access (PENS as Internet Service Provider - ISP) if so requested by the ANSP

### 2.5.1.2 Military Air Navigation Service Providers (ANSPs)

Military adherence to PENS is justified by the need for Military ATM (and/or Air Defence/C2) entities to have comprehensive, accurate and timely flight/trajectory data on all flights currently within their area of responsibility (AoR). They need also access to aeronautical, meteorological, surveillance, and flow and capacity data relating to airspace and aerodromes within that AoR. Civil ATM entities need early sharing of planning information, to improve CDM, and situational awareness of all military air activity. Civil actors should benefit from aeronautical, meteorological, and capacity data relating to military aerodromes. Access to military surveillance capabilities is essential in order to maintain coverage of the relevant area of responsibility (AoR).

CS8 will play a prominent role on civil-military radar/surveillance data sharing to rationalise the surveillance infrastructure and can interconnect Airspace Management (ASM) systems in a distributed environment to enable a common picture of airspace status. This will for example be done through the support of CS4 (Advanced Flexible Use of Airspace Service) for military stakeholders via CS8.
The access to PENS VPN can be provided either via ANSP network or by a dedicated router. The military authorities should locally cooperate with civil ANSPs and communications service providers’ deployment actions to seek the conditions necessary to ensure the continued provision of today and future services.

2.5.1.3 Airspace Users (AU) - Aircraft Operators (AO)
Airspace Users (AU) heavily rely on standard messaging protocols such as Type B / Type X messages to exchange information.

To exchange such messages with ANSPs and / or NM, AUs will rely on the CS8 AU Gateway to forward and receive their message to / from the relevant destination over the network.

The requirements for other type of information exchange will be assessed to expend the functional scope of the AU Gateway if need be.

Airspace users are also expected to rely on PENS for Short Term ATM Measures (STAM) communications.

Airspace users will benefit from PENS connectivity to support Collaboration Decision Making (CDM) operations with ANSPs.

Airspace Users requiring access to the Centralised Services for example for the CS1 or CS5 will use CS8 to do so.

2.5.1.4 Airport Operators
Information flows required by Airport CDM operations between Airport Operators and either ANSPs or NM would be a natural candidate for CS8.

CS8 would also support the exchange of flight data information between ANSPs and Airport Operators.

Airport Operators requiring access to other NM Centralised Services (see section below on NM CS) would use CS8 to do so.

2.5.1.5 Meteorological Information Service Provider
The provisioning of meteorological data flows to NM will be supported by PENS.

2.5.1.6 Other ATM manufacturers and industry partners
Ad-hoc interconnection with other ATM stakeholders such as aircraft manufacturers or ATC / ATM system manufacturers will be accommodated for.

This setup will allow the setting up of connectivity to support the whole life-cycle of ATM products and services development and operations from the validation and verification of a component or service up to the monitoring and maintenance of said component or service.

PENS will accommodate non-critical traffic flows such as validation and verification in a way that will not impact the operational traffic in any way.

These activities would also include support for SESAR-related projects involving SESAR partners or the SESAR Joint Undertaking (SJU) itself.

2.5.1.7 Air / Ground Communication Service Providers (CSP)
Air / Ground Communication Service Providers (CSP) manage a radio infrastructure and an ATN network that support Air / ground data communications.

Their infrastructure has to be interconnected to the ANSP / ACC network and CS8 will offer a practical, secure and cost effective means to achieve this.

CSP could host PENS gateways in their premises to allow ATC data link to flow from the
ANSP network to the CSP network over PENS.
The detailed architecture for CSP interconnection will be further analysed in CS9.
ANSP would thus avoid the setup and management of dedicated connectivity to CSP networks and rely on PENS central gateways for ATC data link traffic.

2.5.1.8 Centralised Services (CS)

CS8 will provide communications services for most of the other Centralised Services and the various types of information flows required by each of them.

Depending on its service level requirements, CS8 will provide connectivity services to:

- The CS datacentre location(s)
- The CS Remote locations

As a high-level architecture principle, each Centralised Service will rely on datacentres hosting the central databases and the main processing activities but also on remote location where the service is ultimately consumed and delivered.

**CS Datacentres**

All the Centralised Services datacentres will be connected to CS8 either to provide access to remote locations over this infrastructure or as a minimum to provide interconnection with other CS datacentres or to NM hosted services.

CS Datacentres will also be relying on PENS to access to the Public Internet in the event that they would rely of Public Internet for part of their communications.

**CS Remote Locations**

Each Centralised Service will require different service level for the remote location connectivity depending on the criticality and the operational impact of the information flow. Some CS will be relying on the CS8 - Public Internet to provide connectivity for Remote Locations, others will rely on CS8 - PENS. In the latter case the standard design will rely on...
Service Delivery Points (or Entry Nodes) to which the PENS connectivity is provided as part of CS8; it will be complemented by a 'last-mile' connection.

The Service Delivery Point concept will be adapted and customized to the needs and business requirements of each and every Centralised Service and the respective CS8 Users. Connectivity to each CS will be studied as part of the Phase1 of the CS Programme.

As part of CS8 Phase I and in coordination with the other CS projects, a detailed analysis of the various traffic flows, their criticality and service characteristics will be performed for each of the Centralised Services. This will lead to the establishment of a detailed set of requirements which will complement the service requirements coming from the other ATM stakeholders and constitute the CS8 requirements baseline.

2.5.1.9 Other NM Services

In order to ensure business continuity the services currently provided by NM from its datacentres in Haren and Brétigny will be supported by CS8 to connect to the remote users (civil and military) but also to the CS Datacentres.

During this transition period, NM services making use of CS8 will include:

- Connection of remote EAD users (civil and military) to the EAD data centres in Austria and Canada
- Connection of remote NM users (CHMI & NOP Portal) to the central NM systems in Brussels / Brétigny
- Connection of remote NM systems (ETFMS Entry Nodes) to the NM systems in Brussels / Brétigny
- Connection to ANSPs for the transmission of flight data information over AFTN / AMHS
- B2B services for some service detailed above through the Public Internet Gateway

2.5.2 The CS8 Service Provider

The CS8 Service Provider is the consortium which will be selected by EUROCONTROL after the CS8 Call for Tenders to provide the CS8 service.

Besides providing the connectivity infrastructure (see Architecture Principles below) the PENS Service Provider will ensure two key functions:

- PTC - PENS Technology Centre (see section 2.4.1)
- POC - PENS Operations Centre (see section 2.4.2)

2.5.3 The EUROCONTROL PENS Management Unit (PMU)

The PENS Management Unit (PMU), a EUROCONTROL entity, will be in charge of the management of CS8, including:

- Management of the CS8 contract and its evolutions to ensure it fulfils at all time the business needs of the CS8 users,
- Management of the relationship with the CS8 Service Provider through the contractual governance and the weekly, monthly and quarterly service meetings,
- Monitoring of the contract performance and service levels (Service Level management)
- Defining CS8 standards, policies and operations practices,
• Monitoring the quality and efficiency of the CS8 process framework and driving its continuous improvement,
• Monitor the performance of the PENS Technology Centre (PTC) and the PENS Operations Centre (POC),
• Monitoring the quality and relevance of the CS8 reporting and driving its continuous improvement,
• Follow-up and coordination of all changes (Change Management) as detailed above in the Change Management process,
• Follow-up and monitoring of the financials contractual elements (Financial Management)
• Support of the service governance with the relevant bodies within EUROCONTROL

The PMU will not be involved in incident management but will act as an escalation path to the CS8 Service Provider.

2.6 Possible evolutions

2.6.1 CS8 geographical scope

Although CS8 initially aims at replacing the cross-border connections between ANSPs in Europe by providing an IP transport service between ATSU’s, it could also provide such connectivity at national level. This could specifically be of interest for those ANSPs that do no benefit from a domestic IP network between their locations or in order to provide a coherent seamless service supporting all ATM operations in Europe.

2.6.2 PENS Operations Centre (POC)

The PENS Operations Centre (POC) will offer opportunities to consolidate some of the Network Operations Centre / Network Management Centre activities currently performed by each ANSP more specifically to aim at providing an end-to-end support service on ATM communication.

The current, fragmented, communication infrastructure supporting ATM communications in Europe leads to a fairly complex and inefficient coordination effort level to provide end-to-end support on the lower communication layers (not to mention the end-to-end application support flow).

The introduction of the PENS Operations Centre will thus not only be a key asset in the efficient use of the PENS network for ATM operations but also open the door to organisational improvements in the end-to-end support of ATM communications.

2.6.3 PENS Technology Centre (PTC)

The PENS Technology Centre will offer support and consulting services to ATM stakeholders around IP networking technologies. This should position the PTC as a centre of technical expertise regarding the implementation of IP technologies in the ATM industry. Such a support engagement will benefit ATM stakeholders, which might not always have the in-house know-how to implement such technologies.
CHAPTER 3 – Regulatory requirements

3.1 Existing applicable regulation

3.1.1 ICAO

At ICAO level, the general requirements for Communications Services are defined in Annex 10 to the Chicago Convention on Aeronautical Telecommunications.

3.1.2 EU SES Package

At the level of European Union, no regulatory provisions address yet specifically the centralised services, and PENS in particular. However, due to the central role of PENS in the network architecture, a large number of SES regulations, in particular related to the Network Manager and to interoperability, are worth considering in relation to CS8:

- Regulation (EC) No 551/2004 of the European parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the SES, (as amended) in particular its Article 6;
- Commission Regulation (EU) No 677/2011 of 7 July 2011 laying down detailed rules for the implementation of air traffic management (ATM) network functions and amending Regulation (EU) No 691/2010), in particular its Article 4.1 which provides that the Network manager shall perform a number a tasks to support the execution of its functions. He shall notably:
  - support the different operational stakeholders in the execution of the obligations that are placed on them in the deployment of ATM/ANS systems and procedures (Art. 4.1(i));
  - ensure appropriate operational coordination, as well as optimisation, interoperability and interconnectivity within its area of responsibility (art. 4.3 (c));
- Commission Regulation (EC) No 29/2009 of 16 January 2009 laying down requirements on data link services for the single European sky; it addresses in its article 5.6 the required monitoring of the quality of service of communication services performance;
- Community specifications 2012/C 168/03 and 2011/C 183/06 related to DLS;
- Commission Implementing Regulation (EU) N 1079/2012 of 16 November 2012 laying down requirements for voice channels spacing for SES;
• Commission Regulation (EU) No 73/2010 of 26 January 2010 laying down requirements on the quality of aeronautical data and aeronautical information for SES;

• Commission Regulation No 633/2007 of 7 June 2007 laying down requirements for the application of a flight message transfer protocol used for the purpose of notification, coordination and transfer of flights between air traffic control units, as amended;


• Commission Regulation (EC) No 482/2008 establishing a software safety assurance system to be implemented by air navigation service providers and amending Annex II to Regulation (EC) No 2096/2005 as amended

It is assumed that the development and operation of PENS 2 will facilitate and improve the execution of the objectives set by these provisions. The following regulations, related to the oversight should also be considered:

• Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency (as amended);


• Commission implementing regulation (EU) No 1034/2011 of 17 October 2011 on safety oversight in air traffic management and air navigation services and amending Regulation (EU) No 691/2010 (as amended): Article 3.d of this Regulation foresees that the safety oversight of organizations providing pan-ATM/ANS is exercised by EASA;

Finally, the European Commission has issued in its Communication of 11 June 20131 a proposal to revise the SES package, with a view notably to reinforce the role of the network manager. The proposal also covers the new notion of ‘support services’ to ATS, which correspond to the centralised services proposed by EUROCONTROL.

3.2 Requirements for new/updated regulations to implement/operate the CS8 (PENS)

3.2.1 Requirements related to the EU framework

A provision in the SES Regulations is necessary to facilitate the technical migration to the future centralised services (or ‘support services’) mandatory for stakeholders concerned (e.g. by a further amendment to Regulation No 677/2011). For CS8 (PENS), provisions should also be envisaged to mandate the use of the service and thus enlarge its current user base.

3.2.2 Requirements related to the EUROCONTROL framework

PENS will be implemented as a Pan-European Service, notably in the applicability area of

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1 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions “Accelerating the Single European Sky” of 11 June 2013 (COM (2012) 408 final)
the EUROCONTROL Member States. To unlock the full benefits for the Network on one side and the ANSPs and other operational stakeholders on the other side, it is pivotal that all Member States cooperate in the set-up and implementation of the service.

While the above-mentioned EU regulations will apply to EU Member States and their operational stakeholders, as well as ultimately to non EU Member States bound by these Regulations because of relevant agreements with the EU for the implementation of aviation regulations (e.g. ECAA), the intention is to achieve consent in the Provisional Council and Permanent Commission of EUROCONTROL to make full use of the services in all EUROCONTROL Member States.

Therefore, it is expected that by a Decision, the Permanent Commission of EUROCONTROL will make the centralised services and their related conditions binding on all the EUROCONTROL Member States and their operational stakeholders. The EU regulatory framework would just reinforce this obligation for the States concerned.

3.2.3 Requirements related to the national legal/regulatory frameworks

Updated/amended EU regulations are directly applicable in the EU Member States and would not require measures at national level.

For EUROCONTROL Member States not bound by EU Regulations, appropriate rules and regulations would have to be adopted at national level to comply with the obligations deriving from the decision of the Permanent Commission of EUROCONTROL.
CHAPTER 4 – Links of the CS8 PENS to ICAO GANP, SESAR deployment, ESSIP – current procedures and future evolution

4.1 Baseline – Interim Deployment Programme (IDP)

Centralised Services (CS) are in line with the Interim Deployment Programme (IDP). The conformity analysis was initiated by EUROCONTROL and further completed at the Interim Deployment Steering Group (IDSG) Expert Team in the meeting of 27 June 2013.

The possible relationships between CS and IDP deployments have been analysed and clustered in four categories of potential interactions, which are:

1. **No relationships** between IDP activities and CS. This means that the functions and services deployed in a centralised manner by the CS do not directly interface any of the deployments of the IDP.

2. IDP deployment is improved by the independent CS capabilities. The functions and services deployed in a centralised manner by the CS will be used by one or several IDP deployments but in an independent way. This is the case when CS does not impact functionalities already deployed, i.e. **Independent function improvements**, or when the CS implements some add-on function or services such as equipment performance monitoring, centralised management of shared parameters, i.e. **Development of supporting option**.

3. IDP is a **pre-requisite** for CS. This means that the functions and services deployed in a centralised manner by the CS reuse an IDP deployment.

4. IDP deployment is an **alternative** to the CS solution. The functions and services deployed in a centralised manner by the CS offer a different implementation of an IDP deployment.

The PENS centralised service proposes enhancements to the existing PENS service and offers add-on functions (PENS Operations Centre and PENS Technology Centre) to allow ATM stakeholders to use PENS as the ATM-grade IP network linking the whole community.

This centralised service is categorised as **development of supporting options**, which means that it will improve cost effectiveness of the operations of the IDP deployments.

Furthermore, it enhances the existing PENS and develops add-on services. The IDP deployments do not address this area but require PENS.
The benefit dependency is that the PENS centralised service improvements to PENS will enable more cost-effective IDP deployments and their wider use due to higher performance and higher confidence brought by the PENS Operation Centre and PENS Technical Centre.

The PENS centralised service is related to almost all of the IDP Work Packages. The figure below illustrates the IDP Breakdown structure for the PENS relevance.

4.2 Pilot Common Projects (PCP) and Common Projects (CP)

Centralised Services interact with the Pilot Common Project (PCP). Interdependencies between Centralised Services and the six ATM Functionalities (AFs) of the Pilot Common Projects (PCP) have been analysed.

The Centralised Services will influence the future Common Projects (CP).

The PENS centralised service can be considered as a generic enabler of several PCP ATM Functionalities as the ground communication layer.

4.3 European Single Sky Implementation (ESSIP)

The possible relationships between CS and ESSIP, being the Level 3 of the European ATM Master Plan, have been analysed.

The PENS centralised service is categorised as development of supporting options and is related to the ESSIP Objectives:

- COM09 “Migrate ground international or regional X.25 data networks or services to the Internet Protocol (IPv6)”
- COM11 “Implementation of Voice over Internet Protocol (VoIP) in ATM”
• ITY-FMTP “Apply a common flight message transfer protocol (FMTP)”

Depending on the evolution of the PENS centralised service, in future, new ESSIP Objectives may have to be developed or existing ones may have to be amended.

4.4 ICAO Global Air Navigation Plan (GANP)

The possible relationships between CS and ICAO Global Air Navigation Plan (GANP) have been analysed.

The PENS centralised service and ICAO GANP in perspective is the European implementation of IPv6 infrastructure (GANP COM roadmap). It addresses some aspects of AN-Conf/12 Rec. 1.6 on data communication issues. The PENS centralised service is an enabler of many modules, such as:

• B1-DATM – Service Improvement through Integration of all Digital ATM Information;
• B1-SWIM – Performance Improvement through the Application of System Wide Information Management (SWIM);
• B1-TBO – Improved Traffic Synchronisation and Initial Trajectory-Based Operation;
• B1-FICE – Increased Interoperability, Efficiency & Capacity through FF-ICE/1 application before Departure;
• B1-NOPS – Enhanced Flow Performance through Network Operational Planning;
• B1-AMET – Enhanced Operational Decisions through Integrated Weather Information (Planning & Near-Term Service); and
• B3-TBO – Full 4D Trajectory-based Operations.
ANNEX 1  – Information flows

A1.1  Operational processes

A1.1.1  Incident Management

[Diagram showing information flows between PENS Technology Centre (PTC), Network Service Provider(s), Other service providers, and PENS Operations Center (POC) with CS8 Users including ANSPs, Airports, Airlines, MIL, CS, and Manufacturers.]
A1.1.2 Change Management (Requests for Changes)
ANNEX 2 – Data set

The Data set will be defined as part of the specifications for the Phase 1 Calls-for-tenders and refined during the Phase 1
ANNEX 3 – EUROCONTROL Proposal for a first set of Centralised Services to contribute to SES Performance Achievement, March 2013

ANNEX 4 – Brief description of the Centralised Services

ANNEX 5 – Minutes of the 29 April 2013 Airspace Users CS workshop

ANNEX 6 – Minutes of the 4 March 2013 Member States CS workshop

ANNEX 7 – Minutes of the 24 April 2013 ANSPs CS workshop

ANNEX 8 – Minutes of the 17 May Manufacturing Industry CS workshop

ANNEX 9 – Working papers, slides and extract from the Minutes of PC/39, 16 May 2013

ANNEX 10 – Working papers, slides and extract from the Minutes of PCC/31, 02 July 2013

ANNEX 11 – Slides and Minutes of CS8 specific workshop of 09 July 2013

These annexes are provided in a separate file
REFERENCES

- COMMISSION REGULATION (EC) No 633/2007 of 7 June 2007 laying down requirements for the application of a flight message transfer protocol used for the purpose of notification, coordination and transfer of flights between air traffic control units
- EUROCONTROL “European Single Sky Implementation ESSIP Plan” Edition 2013 and more specifically, the Objective ‘COM 09’ – Migrate ground international or regional X25 data networks or services to Internet Protocol (IP)
# GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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<tbody>
<tr>
<td>Aeronautical Fixed Telecommunication Network</td>
<td>Worldwide system of aeronautical fixed circuits provided, as part of the Aeronautical Fixed Service, for the exchange of messages and/or digital data between aeronautical fixed stations having the same or compatible communications characteristics</td>
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<tr>
<td>ATS Messaging Handling System (AMHS)</td>
<td>Standard for aeronautical ground-ground communications (e.g. for the transmission of NOTAM, Flight Plans or Meteorological Data) based on X.400 profiles. The ICAO has defined the standard.</td>
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<tr>
<td>Core Network</td>
<td>A core network, or network core, is the central part of a telecommunication network that provides various services to customers who are connected by the access network. Typically the term refers to the high capacity communication facilities that connect primary nodes. Core/backbone network provides paths for the exchange of information between different sub-networks. For enterprise private networks serving one organization, the term backbone is more used, while for service providers, the term core network is more used.</td>
</tr>
<tr>
<td>Customer Premises Equipment (CPE)</td>
<td>Customer-premises equipment or customer-provided equipment (CPE) is any terminal and associated equipment located at a subscriber's premises and connected with a carrier's telecommunication channel at the demarcation point (&quot;demarc&quot;). The demarc is a point established in a building or complex to separate customer equipment from the equipment located in either the distribution infrastructure or central office of the Communications Service Provider.</td>
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<tr>
<td>E1 Circuit</td>
<td>An E1 link operates over two separate sets of wires, usually Unshielded twisted pair (balanced cable) or using coaxial (unbalanced cable). A nominal 3-volt peak signal is encoded with pulses using a method avoiding long periods without polarity changes. The line data rate is 2.048 Mbit/s (full duplex, i.e. 2.048 Mbit/s downstream and 2.048 Mbit/s upstream), which is split into 32 timeslots, each being allocated 8 bits in turn.</td>
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<tr>
<td>ICAO EUR/NAT</td>
<td>ICAO European and North Atlantic Region</td>
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| Leased Lines                               | Service contract between a provider and a customer, whereby the provider agrees to deliver a symmetric telecommunications line connecting two or more locations in exchange for a monthly rent (hence the term lease). It is sometimes known as a "private circuit" or "data line" in the UK. Unlike traditional PSTN lines it does not have a
<table>
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<tr>
<th><strong>Centralised Service on Pan European Network Services (PENS) Concept of Operations (CONOPS)</strong></th>
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<tr>
<td><strong>telephone number, each side of the line being permanently connected to the other. Leased lines can be used for telephone, data or Internet services.</strong></td>
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<tr>
<td><strong>Metro Ethernet</strong></td>
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<tr>
<td>A metropolitan-area Ethernet, Ethernet MAN, or metro Ethernet network is a metropolitan area network (MAN) that is based on Ethernet standards. It is commonly used to connect subscribers to a larger service network or the Internet. Businesses can also use metropolitan-area Ethernet to connect their own offices to each other.</td>
</tr>
<tr>
<td><strong>IP Router</strong></td>
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<tr>
<td>A router is a device that forwards data packets between computer networks, creating an overlay internetwork. A router is connected to two or more data lines from different networks. When a data packet comes in one of the lines, the router reads the address information in the packet to determine its ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey. A data packet is typically forwarded from one router to another through the networks that constitute the internetwork until it reaches its destination node.</td>
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<tr>
<td><strong>Time Division Multiplexing (TDM)</strong></td>
</tr>
<tr>
<td>Method of transmitting and receiving independent signals over a common signal path by means of synchronized switches at each end of the transmission line so that each signal appears on the line only a fraction of time in an alternating pattern.</td>
</tr>
<tr>
<td><strong>Type B</strong></td>
</tr>
<tr>
<td>Type B is a messaging standard used by the Air Transport industry (not just airlines). Initially it was used as mechanism to send short messages to ensure bookings and reservations were guaranteed. Typically reservations and seat booking messages are less than 300 characters in length and contained many abbreviations that originally only trained operators could understand. Type B is also used for the transmission of flight plans, departure control messages and cargo manifests. However typically airlines try to avoid the large use of long message formats owing to the cost of transmission.</td>
</tr>
<tr>
<td><strong>Type X</strong></td>
</tr>
<tr>
<td>Type X is a messaging format that uses XML based standards. It is a way of reducing some of the limitations within the Type B messaging format, particularly with respect to message size. The take up of Type X has been mainly with airline partners or suppliers that have no need of legacy transmissions but can interchange messages with Type B users. It is relatively new (in comparison with Type B history). It is uncertain if there is a large take up of Type X at this stage.</td>
</tr>
<tr>
<td><strong>Unicast / Multicast</strong></td>
</tr>
<tr>
<td>Unicast transmission is the sending of messages to a single network destination identified by a unique address. Multicast is the delivery of a message or information to a group of destination computers simultaneously in a single transmission from the source. Copies are automatically created in other network elements, such as routers, but only when the topology of the network requires it.</td>
</tr>
<tr>
<td><strong>X.25</strong></td>
</tr>
</tbody>
</table>
| X.25 is an ITU-T standard protocol suite for packet switched wide */
area network (WAN) communication. While X.25 has been, to a large extent, replaced by less complex protocols, especially the Internet protocol (IP), the service is still used and available in niche and legacy applications.
## ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ACCS</td>
<td>Air Command and Control System</td>
</tr>
<tr>
<td>AFTN</td>
<td>Aeronautical Fixed Telecommunication Network</td>
</tr>
<tr>
<td>APSL</td>
<td>Airport Slot</td>
</tr>
<tr>
<td>AMHS</td>
<td>ATS Message Handling System</td>
</tr>
<tr>
<td>ANS</td>
<td>Air Navigation Service</td>
</tr>
<tr>
<td>ANSP</td>
<td>Air Navigation Service Provider</td>
</tr>
<tr>
<td>AO</td>
<td>Aircraft Operator</td>
</tr>
<tr>
<td>ATC</td>
<td>Air Traffic Control</td>
</tr>
<tr>
<td>ATFCM</td>
<td>Air Traffic Flow Control Measure</td>
</tr>
<tr>
<td>ATM</td>
<td>Air Traffic Management</td>
</tr>
<tr>
<td>ATN</td>
<td>Aeronautical Telecommunication Network</td>
</tr>
<tr>
<td>ATS</td>
<td>Air Traffic Service</td>
</tr>
<tr>
<td>ATSU</td>
<td>Air Traffic Service Unit</td>
</tr>
<tr>
<td>AU</td>
<td>Airspace User</td>
</tr>
<tr>
<td>A/G</td>
<td>Air / Ground</td>
</tr>
<tr>
<td>B2B</td>
<td>Business to Business</td>
</tr>
<tr>
<td>B2C</td>
<td>Business to Customer</td>
</tr>
<tr>
<td>CHMI</td>
<td>Common Human Machine Interface.</td>
</tr>
<tr>
<td>CONOPS</td>
<td>Concept of Operations</td>
</tr>
<tr>
<td>CPE</td>
<td>Customer Premise Equipment</td>
</tr>
<tr>
<td>CS</td>
<td>Centralised Service</td>
</tr>
<tr>
<td>CSP</td>
<td>Communication Service Provider, in particular for Air / Ground</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
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<tr>
<td>--------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>DNS</td>
<td>Domain Name System</td>
</tr>
<tr>
<td>ECAA</td>
<td>European Common Aviation Area</td>
</tr>
<tr>
<td>ECAC</td>
<td>European Civil Aviation Conference</td>
</tr>
<tr>
<td>ETFMS</td>
<td>Enhanced Tactical Flow Management System</td>
</tr>
<tr>
<td>FMTP</td>
<td>Flight Message Transfer Protocol</td>
</tr>
<tr>
<td>FPD</td>
<td>Flight Plan Data</td>
</tr>
<tr>
<td>FPL</td>
<td>Flight Plan</td>
</tr>
<tr>
<td>GA/BA</td>
<td>General Aviation / Business Aviation</td>
</tr>
<tr>
<td>IATA</td>
<td>International Air Transport Association</td>
</tr>
<tr>
<td>ICAO</td>
<td>International Civil Aviation Organization</td>
</tr>
<tr>
<td>IFPS</td>
<td>Integrated Initial Flight Planning System</td>
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<tr>
<td>IP</td>
<td>Internet Protocol</td>
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<tr>
<td>ISP</td>
<td>Internet Service Provider</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunications Union</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
</tr>
<tr>
<td>LARA</td>
<td>Local and sub-Regional ASM System</td>
</tr>
<tr>
<td>MINS</td>
<td>Managed Integrated Network Services</td>
</tr>
<tr>
<td>NM</td>
<td>Network Manager</td>
</tr>
<tr>
<td>NMOC</td>
<td>Network Manager Operations Centre</td>
</tr>
<tr>
<td>NTP</td>
<td>Network Time Protocol</td>
</tr>
<tr>
<td>PENS</td>
<td>Pan European Network Service</td>
</tr>
<tr>
<td>POC</td>
<td>PENS Operations Centre</td>
</tr>
<tr>
<td>PTC</td>
<td>PENS Technology Centre</td>
</tr>
<tr>
<td>SPOF</td>
<td>Single Point Of Failure</td>
</tr>
<tr>
<td>STAM</td>
<td>Short Term ATFCM Measures</td>
</tr>
<tr>
<td>SWIM</td>
<td>System Wide Information Management</td>
</tr>
<tr>
<td>TDM</td>
<td>Time Division Multiplexing</td>
</tr>
<tr>
<td>VoIP</td>
<td>Voice over IP</td>
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