



# EUR IPv6 address space allocation

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## References

- [1] ICAO Annex 10 — Aeronautical Telecommunications, Volume III — Communication Systems
- [2] ICAO Doc 9896: Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols, Second Edition – 2015
- [3] ICAO Doc 7754: EUR Air Navigation Plan
- [4] RIPE IPv6 Address Allocation and Assignment Policy, ripe-589, May 2013
- [5] EUROCONTROL LIR Network Address Assignments, March 2015
- [6] RFC 3531 (A Flexible Method for Managing the Assignment of Bits of an IPv6 Address Block), April 2003

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## Contacts

IPv6 address space allocation requests are sent as follows:

1. To EUROCONTROL for ECAC Users within the ICAO EUR Region at:

email: [ipv6@eurocontrol.int](mailto:ipv6@eurocontrol.int)

2. To the ICAO EUR/NAT Office for Non-ECAC Users within the ICAO EUR Region by using the template provided in Attachment B of this document at:

e-mail: [icaoeurnat@icao.int](mailto:icaoeurnat@icao.int)

All inquiries, reports and proposals for modification concerning this document should be forwarded to:

e-mail: [icaoeurnat@icao.int](mailto:icaoeurnat@icao.int)

The ICAO EUR/NAT Office ensures that the information is forwarded to the appropriate working groups (e.g. Planning Group of AST TF)

The EUR IPv6 address space allocation document is published by the ICAO EUR/NAT Office as restricted document.

Appendix A is provided to the ICAO EUR/NAT Office and it is intended to be updated on annual basis. However, due to security concerns its distribution will be limited and under strict control of ICAO and EUROCONTROL.

# 1 **Scope**

## 1.1. **Scope of the document**

- 1.1.1. The purpose of this document is to describe the IPv6 addressing methodology adopted in EUR and the process of allocation of IPv6 address space to legitimate users in the Region as carried out by EUROCONTROL on behalf of the ICAO EUR/NAT Regional Office.
- 1.1.2. The geographical scope of this document is the ICAO EUR Region as defined by  
[http://www.icao.int/EURNAT/Pages/member\\_states.aspx](http://www.icao.int/EURNAT/Pages/member_states.aspx)
- 1.1.3. The technical scope consists in the establishment and application of a procedure, based on the RIPE IPv6 Allocation and Assignment Policy, for meeting the ICAO Doc 9896 Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols and the ICAO Doc 7754 EUR Air Navigation Plan requirements in the frame of ATN/IPS implementation.
- 1.1.4. The Document provides additional guidance for EUR IPv6 address space allocation and includes in Appendix A the EUR IPv6 address space allocations performed by EUROCONTROL as Local Internet Registry (LIR).

## 1.2. **Document Overview**

- 1.2.1. The document includes the following Chapters:
  - The first Chapter deals with the scope, structure, terminology and abbreviations used in the document.
  - The second Chapter introduces and explains the background of the EUR IPv6 address space allocation.
  - The third Chapter recalls the IPS Network Addressing Requirements and the applied EUR IPv6 addressing scheme.
  - The fourth Chapter deals with the role and responsibilities of EUROCONTROL as the Local Internet Registry in the Region.
  - The fifth Chapter deals with details on IPv6 Address-space allocation principles, responsibilities and stepwise procedure.
- 1.2.2. Attachment A of this document includes the Change Control Mechanism of the EUR IPv6 address space allocation document.
- 1.2.3. Attachment B of this document includes the IPv6 address space allocation request (AR) template for Non-ECAC Users.
- 1.2.4. Appendix A includes the following table:
  - EUR IPv6 address space allocation

- 1.2.5. Appendix A is provided to the ICAO EUR/NAT Office and it is intended to be updated on annual basis. However, due to security concerns its distribution will be limited and under strict control of ICAO and EUROCONTROL.

### 1.3. Terminology

- 1.3.1. All definitions in this document are based on proposals from [2] - ICAO Doc 9896: Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols, Second Edition – 2015 and [4] - RIPE IPv6 Address Allocation and Assignment Policy, ripe-589, May 2013.

### 1.4. Abbreviations

- 1.4.1. The following abbreviations are used in this document:

AFSG	Aeronautical Fixed Service Group (ICAO EANPG)
AMHS	ATS Message Handling System
ANSP	Air Navigation Service provider
AS	Autonomous system
AST PG	Planning Group of AST TF
AST TF	AFS to SWIM Transition Task Force
ATC	Air Traffic Control
ATN	Aeronautical telecommunication network
ATSU	Air traffic service unit
BGP	Border gateway protocol
CSP	Communication Service Provider
EANPG	European Air Navigation Planning Group (ICAO)
EASPG	European Aviation System Planning Group (ICAO)
<a href="#">EIPR</a>	<a href="#">European IPS Repository</a>
EU	End User
EUR/NAT	ICAO Region Europe / North Atlantic
FAB	Functional Airspace Block
HD	Host-Density
IANA	Internet assigned numbers authority
ICAO	International Civil Aviation Organisation
IP	Internet protocol
iPAX	Internet Protocol for Aeronautical Exchange
IPS	Internet Protocol Suite
IPv4	Internet protocol version 4
IPv6	Internet protocol version 6
IR	Internet Registry
ISP	Internet Service Provider
LAN	Local Area Network
LIR	Local Internet registry
NAT-PT	Network Address Translation-Protocol Translation
NIR	National Internet Registry
PCG	EASPG Programme Coordination Group
PG	Planning Group (see AST PG)
RFC	Request for Comments
RIPE	Réseaux IP Européens (European Internet Authority)
RIR	Regional Internet Registry
SLA ID	Site Level Aggregation Identifier



## 2 Introduction

### 2.1. Background

- 2.1.1. IP Version 6 Addressing (IPv6) has been adopted by the IETF and the internet authorities to cope with the ever increasing growth rate of the global internet. IPv6 solves many of the technical problems associated with IPv4, in particular the limited IPv4 address space.

*Note. — IPv6 uses 128 bit addresses versus 32 in IPv4.*

- 2.1.2. The ICAO ATN/IPS is based on IPv6 so that it may take immediate advantage of new commercial off-the-shelf products and technologies while setting a solid yet flexible foundation for the roll-out of next generation ATM applications and services globally.
- 2.1.3. In the EUR Region, the commitment to use IP technologies for the AFS was made well in advance of ICAO global Planning, as reflected in the EUR ANP.
- 2.1.4. In this direction, EUROCONTROL set up the iPAX-Task Force in 2001 with the mandate to develop guidelines, specifications and possibly aeronautical standards related to the exchange of data between ATS or CNS systems based on the TCP/IP protocol suite. One of the major outcomes of this work was the elaboration of a EUR IPv6 Addressing scheme which would be necessary to support the deployment of envisaged large-scale pan-European network services.
- 2.1.5. EUROCONTROL applied to RIPE (the European Internet Authority) for the Local Internet Registry (LIR) status in November 2004. This was accepted in December 2004.
- 2.1.6. In a subsequent step, recognising the benefits of IPv6 and in order to support the evolution of the EUR IP based AFS networks and ensure unique and unambiguous addressing of systems utilizing IP network services, the EANPG concluded (EANPG 52/24) that:
- 2.1.6.1. “...- States should develop national plans, in line with the ICAO Manual on the Aeronautical Telecommunication Network (ATN) using Internet Protocol Suite (IPS) Standards and Protocols (Doc 9896), for migration to IPv6 taking the existing IPv4 based aeronautical systems into account; and
- 2.1.6.2. - States should consider the use of IPv4/IPv6 protocol translation devices only as a provisional solution during the migration; ...”
- 2.1.7. To support the ongoing implementation of IPv6 in EUR AFS, it is necessary to:
- ensure the allocation of IPv6 address space for Regional use;
  - implement a methodology for the appropriately allocating and registering IPv6 address space within the Region;
  - develop guidance for the assignment of IPv6 addresses to users
- 2.1.8. The present document outlines the procedures, means, roles and responsibilities applied in the EUR Region to effectively address above requirements.
- 2.1.9. EUROCONTROL supports the above activities on behalf of the ICAO EUR/NAT Office, as foreseen in the Document.

- 2.1.10. The following users are currently concerned by these activities: ANSPs, FABs, Communication Service Providers (CSP) and the EUROCONTROL/Network Manager. In the future other categories of users like MIL ANSPs, Airports and Airlines may be included.

### **3     IPS Network Addressing Specifications**

#### **3.1. Requirements**

3.1.1. This section summarises pertinent requirements on Network Addressing and Inter-domain routing as specified in section 2.3 (Internet Layer Requirements) of ICAO Doc 9896, Second Edition 2015.

##### **3.1.2. IPS Network Addressing**

3.1.2.1. IPS nodes shall implement IP Version 6 Addressing Architecture as specified in RFC 4291.

3.1.2.2. IPS nodes shall use globally scoped IPv6 addresses when communicating over the ATN/IPS.

3.1.2.3. Administrative Domains shall obtain IPv6 address prefix assignments from their Local Internet Registry (LIR) or Regional Internet Registry (RIR).

##### **3.1.3. IPS Inter-Domain Routing**

*Note 1. — Inter-domain routing protocols are used to exchange routing information among ASs.*

*Note 2. — For routing purposes, an AS has a unique identifier called an AS number.*

*Note 3. — A single Administrative Domain may be responsible for the management of several ASs.*

*Note 4. — The routing protocol within an AS is a local matter determined by the managing organization.*

3.1.3.1. IPS routers shall implement the Border Gateway Protocol (BGP-4) as specified in RFC 4271 for inter-domain routing across Administrative Domains.

3.1.3.2. IPS routers which support inter-domain dynamic routing shall implement the BGP-4 multiprotocol extensions as specified in RFC 2858.

3.1.3.3. Administrative Domains shall use AS numbers for ATN/IPS routers that implement BGP-4.

3.1.3.4. IPS routers that implement the Border Gateway Protocol (BGP-4) for inter-domain routing across Administrative Domains shall follow the AS numbering plan.

*Note. — Administrative Domains that require additional private AS numbers should coordinate through ICAO.*

3.1.3.5. IPS routers which support inter-domain dynamic routing should authenticate routing information exchanges as specified in RFC 2385.

## 3.2. Applied addressing scheme

3.2.1. This section summarises the applied EUR IPv6 addressing scheme.

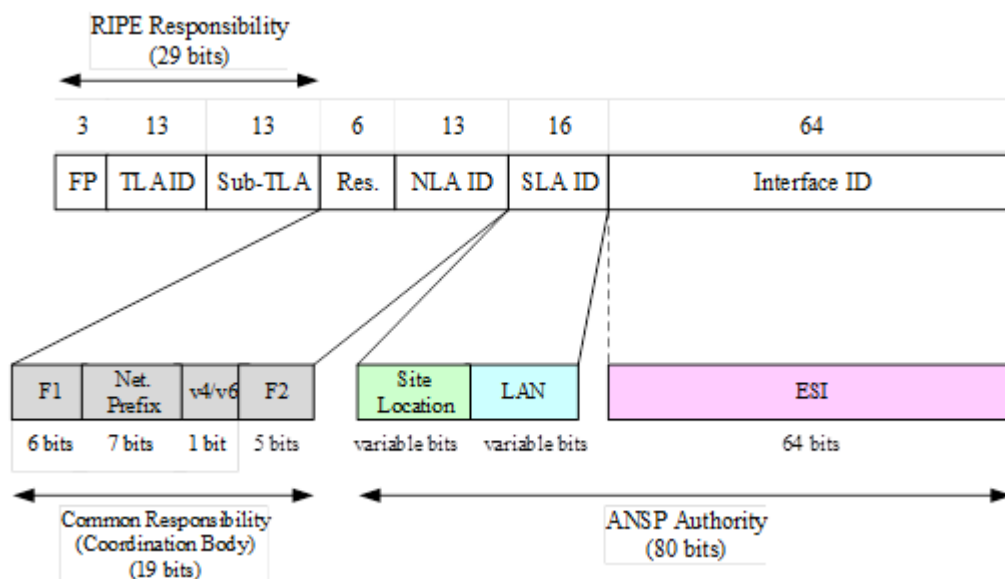
3.2.1.1. This scheme was developed and tested within the context of the EUROCONTROL iPAX-TF. It was supported by the EUROCONTROL COMT in 2005 (COMT/33) and applied since then by EUROCONTROL while performing its Local Internet Registry (LIR) function in RIPE.

3.2.1.2. The scheme was updated in 2018 to reflect the extension to /29 EUROCONTROL LIR allocation.

### 3.2.2. IPS Network Addressing

3.2.2.1. The EUR IPv6 addressing scheme is illustrated in Figure 1.

3.2.2.2. The addressing scheme follows on from the RIPE allocation to provide /48 assignments, where /xx corresponds to the prefix-length (a decimal value specifying how many of the leftmost contiguous bits of the address comprise the address prefix).



**Figure 1- EUR IPv6 addressing scheme**

3.2.2.3. The legitimate users (ANSPs, FABs, Communication Service Providers (CSP) and the EUROCONTROL/Network Manager) are responsible for the management of their /48 assignment. Each user will make an address plan for their subnets to accommodate their IPv6 capable systems.

3.2.2.4. The legitimate users are free to allocate beyond the /48 boundary i.e. SLA ID and Interface ID/(ESI). This would correspond to a typical allocation from an ISP and ensure service provider independence in case of future infrastructure evolution or additional network resilience (multi-homed).

3.2.2.5. There is no restriction on the users for sub-netting the SLA ID field. Normally, the Interface ID (ESI) of an IPv6 node is typically defined by the end-station's MAC address.

3.2.2.6. To summarise the iPAX addressing scheme:

- The first 29 bits are fixed to 2001:4b50 (RIPE allocation)
- The 6 bits of Field F1 are reserved for future use (F1 is set to 0). Depending on the expansion strategy of the addressing scheme, either the F1 field could be used to extend the Net Prefix or another /29 RIPE allocation can be requested.
- The 7 bits of the fixed "Net. Prefix" field are used to number each ANSP, organisation or infrastructure that can be considered as a single entity connected to the EUR AFS.
- The 1 bit of the v4/v6 field is a toggle bit to indicate if IP address translation is required at the network border. If set to 1, it indicates a v4 node and if set to 0, it indicates a v6 node. When this bit is set to 1, an edge router running NAT-PT must translate the IPv6 address to the real internal IPv4 address. If in the future translations are not needed, this bit can be added to the Net prefix.
- The 5 bits of F2 field are based on the information advised in RFC 3531 (A Flexible Method for Managing the Assignment of Bits of an IPv6 Address Block). By using the 5 bits from left to right (rather than the more traditional right to left) more efficient aggregation can be achieved when routing.

Assignment Number	Binary	Hex	Network Name
1	00000	0	First Operational
2	10000	10	First Pre-Operational
3	01000	8	Second Operational
4	11000	18	Second Pre-Operational
5	00100	4	Third Operational
6	10100	14	Third Pre-Operational
7	01100	C	....
8	11100	1C	....
9	00010	2	....
....	....		
....	....		
32	11111	1F	....

**Table 1-F2 Field Bit Level Assignments**

- 3.2.2.7. Legitimate users assign the remaining 80 bits of the address based on their own policies but should note the advice provided in RFC 3531 (A Flexible Method for Managing the Assignment of Bits of an IPv6 Address Block).
- 3.2.2.8. As an example, the first operational real network assigned to ROMATSA is 2001:4B50:0940::/48. If ROMATSA requested a second operational real network, the F2 bits would be “01000” which is equivalent in hex to “8”. So its assignment would be 2001:4B5:0948::/48, its third would be 2001:4B5:0944::/48, and so on.
- 3.2.2.9. It is recommended for legitimate users to assign their network addresses using the same principle for the “Site Location” and “LAN” fields.

### 3.2.3. IPv6 allocation example

- 3.2.3.1. ROMATSA has been sub-allocated with the following address space and can advertise IPv6 network prefix 2001:4B50:0940::/42 at their border.

```

inet6num:      2001:4B50:0940::/42
netname:         RO-ROMATSA
descr:          Allocation to the Romanian ANSP (ROMATSA)
country:        RO
admin-c:        CA1732-RIPE
tech-c:         CD1668-RIPE
status:         ALLOCATED-BY-LIR
mnt-lower:      EURO-HQ-MNT
mnt-by:         EURO-HQ-MNT
source:         RIPE # Filtered

```

- 3.2.3.2. ROMATSA has been assigned the following /48 network prefixes to number their systems. These addresses are indicated as being maintained by EUROCONTROL.

<b><u>inet6num:</u></b>	2001:4B50:0940::/48	<b><u>inet6num:</u></b>	2001:4B50:0960::/48
netname:	RO-ROMATSA-OR-1	netname:	RO-ROMATSA-OV-1
descr:	Assignment for site RO-ROMATSA-OR-1	descr:	Assignment for site RO-ROMATSA-OV-1
country:	RO	country:	RO
admin-c:	<a href="#">CA1732-RIPE</a>	admin-c:	<a href="#">CA1732-RIPE</a>

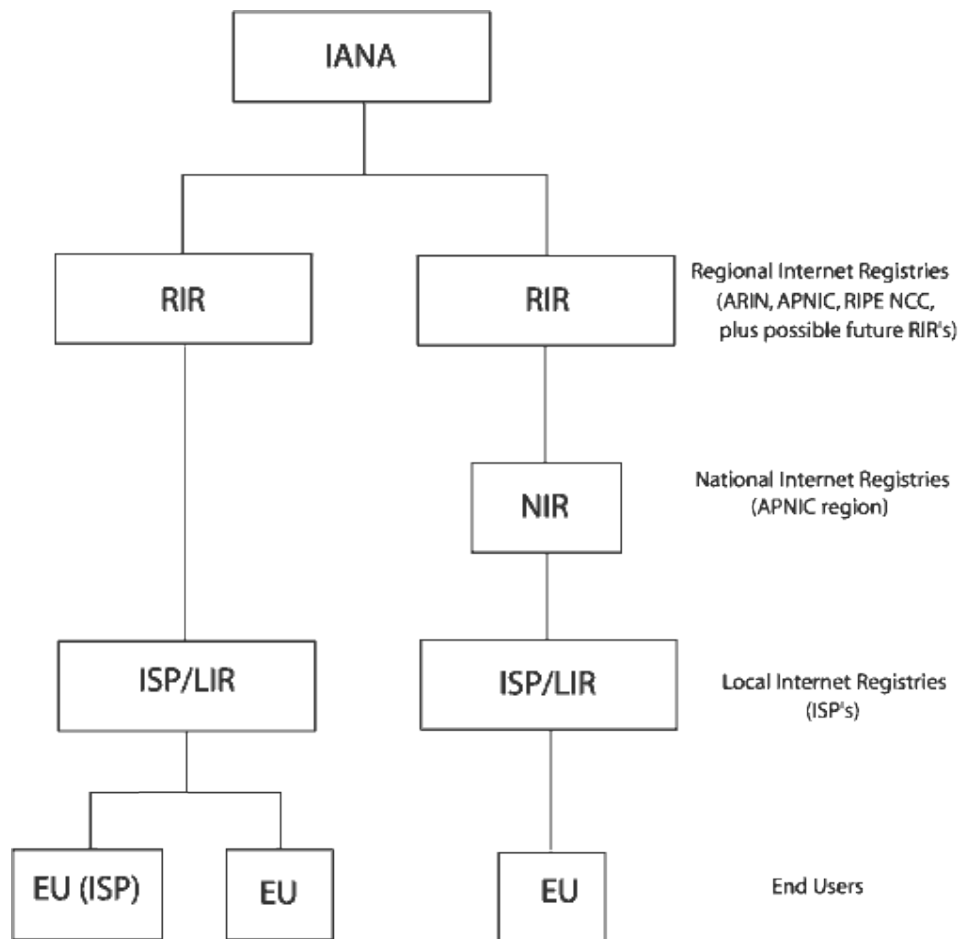
tech-c: <a href="#">CD1668-RIPE</a>	tech-c: <a href="#">CD1668-RIPE</a>
status: ASSIGNED	status: ASSIGNED
mnt-by: <a href="#">EURO-HQ-MNT</a>	mnt-by: <a href="#">EURO-HQ-MNT</a>
source: RIPE # Filtered	source: RIPE # Filtered
<b><u>inet6num:</u></b> 2001:4B50:0950::/48	<b><u>inet6num:</u></b> 2001:4B50:0970::/48
netname: RO-ROMATSA-PR-1	netname: RO-ROMATSA-PV-1
descr: Assignment for site RO-ROMATSA-PR-1	descr: Assignment for site RO-ROMATSA-PV-1
country: RO	country: RO
admin-c: <a href="#">CA1732-RIPE</a>	admin-c: <a href="#">CA1732-RIPE</a>
tech-c: <a href="#">CD1668-RIPE</a>	tech-c: <a href="#">CD1668-RIPE</a>
status: ASSIGNED	status: ASSIGNED
mnt-by: <a href="#">EURO-HQ-MNT</a>	mnt-by: <a href="#">EURO-HQ-MNT</a>
source: RIPE # Filtered	source: RIPE # Filtered

*Table 2-Example of IPv6 address space allocation*

## 4 Role and responsibilities of EUROCONTROL as the Local Internet Registry (LIR) in the Region

### 4.1. Global IPv6 allocation context and summary of IR Responsibilities

- 4.1.1. This section had been extracted from RIPEs “IPv6 Allocation and Assignment Policy” document (ripe-589 May 2013). It should be noted that this policy may be reviewed by RIPE through its experiences of allocations and assignments.
- 4.1.2. Responsibility for management of IPv6 address spaces is distributed globally in accordance with the hierarchical structure shown below.



**Figure 2 - Responsibility for management of IPv6 addresses**



## 4.2. Roles and Definitions

### 4.2.1. Internet Registry (IR)

- 4.2.1.1. An Internet Registry is an organisation that is responsible for distributing IP address space to its members or customers and for registering those distributions. IRs are classified according to their primary function and territorial scope within the hierarchical structure depicted in Figure 2.

### 4.2.2. Regional Internet Registry (RIR)

- 4.2.2.1. Regional Internet Registries are established and authorised by respective regional communities and recognised by the IANA to serve and represent large geographical regions. The primary role of RIRs is to manage and distribute public Internet address space within their respective regions.
- 4.2.2.2. The European RIR is RIPE. <http://www.ripe.net/ripe>.
- 4.2.2.3. EUR IPv6 address space assignments are required to be registered within the European Regional Internet Registry (RIPE) in order to be protected before being used operationally.

### 4.2.3. Local Internet Registry (LIR)

- 4.2.3.1. A Local Internet Registry is an IR that primarily assigns address space to the users of the network services that it provides. LIRs are generally ISPs whose customers are primarily End Users and possibly other ISPs.
- 4.2.3.2. In the context of this document, EUROCONTROL is acting as an LIR and legitimate users are considered ISPs (ref. section 4.4 LIR set-up).

### 4.2.4. Allocate

- 4.2.4.1. To “allocate” means to distribute address space to IRs for the purpose of subsequent distribution by them.

### 4.2.5. Assign

- 4.2.5.1. To “assign” means to delegate address space to an ISP or End User for specific use within the Internet infrastructure they operate. Assignments must only be made for specific purposes documented by specific organisations and are not to be sub-assigned to other parties.

## 4.3. Policies for allocations and assignments

- 4.3.1. This section had been extracted from RIPEs “IPv6 Allocation and Assignment Policy” document (ripe-589 May 2013).

### 4.3.2. Initial allocation

- 4.3.2.1. To qualify for an initial allocation of IPv6 address space, an organisation must: a) be an LIR and b) have a plan for making sub-allocations to other organisations and/or End Site assignments within two years.

- 4.3.2.2. Organisations that meet the initial allocation criteria are eligible to receive an initial allocation of /32. For allocations up to /29 no additional documentation is necessary. Organisations may qualify for an initial allocation greater than /29 by submitting documentation that reasonably justifies the request. If so, the allocation size will be based on the number of existing users and the extent of the organisation's infrastructure.

#### 4.3.3. LIR-to-ISP allocation

- 4.3.3.1. There is no specific policy for an organisation (LIR) to allocate address space to subordinate ISPs. Each LIR organisation may develop its own policy for subordinate ISPs to encourage optimum utilisation of the total address block allocated to the LIR. However, all /48 assignments to End Sites are required to be registered either by the LIR or its subordinate ISPs in such a way that the RIR/NIR can properly evaluate the HD-Ratio when a subsequent allocation becomes necessary.

#### 4.3.4. Assignment

- 4.3.4.1. LIRs must make IPv6 assignments in accordance with the following provisions.

#### 4.3.5. Assignment address space size

- 4.3.5.1. End Users are assigned an End Site assignment from their LIR or ISP. The size of the assignment is a local decision for the LIR or ISP to make, using a minimum value of a /64 (only one subnet is anticipated for the End Site).

#### 4.3.6. Assignments shorter than a /48 to a single End Site

- 4.3.6.1. When a single End Site requires an assignment shorter than a /48, it must request the assignment with documentation or materials that justify the request. Requests for multiple or additional prefixes exceeding a /48 assignment for a single End Site will be processed and reviewed (i.e., evaluation of justification) at the RIR/NIR level.

*Note. — There is no experience at the present time with the assignment of multiple network prefixes to the same End Site. Having the RIR review all such assignments is intended to be a temporary measure until some experience has been gained and some common policies can be developed. In addition, additional work at defining policies in this space will likely be carried out in the near future.*

## 4.4. LIR set-up

- 4.4.1. Following the global IPv6 allocation and assignment policy, EUROCONTROL applied to RIPE for LIR status; this was granted in December 2004.
- 4.4.2. EUROCONTROL requested its first IPv6 allocation and received the standard LIR /32 allocation in January 2005. During 2017 EUROCONTROL allocation was extended by RIPE to LIR /29 as listed in the inet6num object extracted from the RIPE database (<http://www.ripe.net/db/index.html>).
- 4.4.3. From the initial LIR /32 allocation, EUROCONTROL had begun the allocation of IPv6 address space to ANSPs, FABs, Communication Service Providers (CSP) and the EUROCONTROL/Network Manager in accordance with the RIPE “IPv6 Allocation and Assignment Policy”.

## 4.4.4. Current allocation RIPE database extract is:

```
inet6num: 2001:4b50::/29
netname:  BE-EUROCONTROL-20050131
country:  BE
org:      ORG-EitE1-RIPE
status:   ALLOCATED-BY-RIR
created:  2017-11-07T13:22:19Z
last-modified: 2017-11-07T13:22:19Z
source:   RIPE
```

## **5 IPv6 Address-space allocation principles, responsibilities and stepwise procedure**

### **5.1. Principles of IPv6 Address space management**

5.1.1. This section had been extracted from the RIPE “IPv6 Allocation and Assignment Policy” document (ripe-589 May 2013). It should be noted that this policy may be reviewed by RIPE through its experiences of allocations and assignments. The following principles are applied for IPv6 address space allocation processes.

#### 5.1.2. Goals

5.1.2.1. IPv6 address space is a public resource that must be managed in a prudent manner with regards to the long-term interests of the Internet. Responsible address space management involves balancing a set of sometimes competing goals. The following are the goals relevant to IPv6 address policy.

#### 5.1.3. Uniqueness

5.1.3.1. Every assignment and/or allocation of address space must guarantee uniqueness worldwide. This is an absolute requirement for ensuring that every public host on the Internet can be uniquely identified.

#### 5.1.4. Registration

5.1.4.1. Internet address space must be registered in a registry database accessible to appropriate members of the Internet community. This is necessary to ensure the uniqueness of each Internet address and to provide reference information for Internet troubleshooting at all levels, ranging from all RIRs and IRs to End Users.

5.1.4.2. The goal of registration should be applied within the context of reasonable privacy considerations and applicable laws.

#### 5.1.5. Aggregation

5.1.5.1. Wherever possible, address space should be distributed in a hierarchical manner, according to the topology of network infrastructure. This is necessary to permit the aggregation of routing information by ISPs and to limit the expansion of Internet routing tables.

5.1.5.2. This goal is particularly important in IPv6 addressing, where the size of the total address pool creates significant implications for both internal and external routing.

5.1.5.3. IPv6 address policies should seek to avoid fragmentation of address ranges.

5.1.5.4. Further, RIRs should apply practices that maximise the potential for subsequent allocations to be made contiguous with past allocations currently held. However, there can be no guarantee of contiguous allocation.

#### 5.1.6. Conservation

5.1.6.1. Although IPv6 provides an extremely large pool of address space, address policies should avoid unnecessarily wasteful practices. Requests for address space should be supported by appropriate documentation and stockpiling of unused addresses should be avoided.

5.1.7. Fairness

5.1.7.1. All policies and practices relating to the use of public address space should apply fairly and equitably to all existing and potential members of the Internet community, regardless of their location, nationality, size, or any other factor.

5.1.8. Minimised overhead

5.1.8.1. It is desirable to minimise the overhead associated with obtaining address space. Overhead includes the need to go back to RIRs for additional space too frequently, the overhead associated with managing address space that grows through a number of small successive incremental expansions rather than through fewer, but larger, expansions.

5.1.9. Conflict of goals

5.1.9.1. The goals described above will often conflict with each other, or with the needs of individual IRs or End Users. All IRs evaluating requests for allocations and assignments must make judgments, seeking to balance the needs of the applicant with the needs of the Internet community as a whole.

5.1.9.2. In IPv6 address policy, the goal of aggregation is considered to be the most important.

## 5.2. Responsibilities and stepwise procedure

### 5.2.1. Step by step procedure for LIR and Legitimate Users

#### 5.2.1.1. IPv6 address space allocation

STEP 0: EUROCONTROL, as LIR, defined an IPv6 address space allocation plan in which European ANSPs, FABs, Communication Service Providers (CSPs) and the EUROCONTROL/Network Manager were initially assigned a network prefix. On the basis of this network prefix, each organisation can advertise a /42 IPv6 address prefix at their network border as listed in Table 1 of Appendix A.

STEP 1: To register the planned IPv6 allocations and assignments, ECAC Users (States, ANSPs and other legitimate users such as FABs and pan-European and regional CSPs) shall contact EUROCONTROL LIR and provide an administrative and technical contact for the address space assignment. Requests to be sent to [ipv6@eurocontrol.int](mailto:ipv6@eurocontrol.int).

*Note 1:* RIPE is requesting a minimum of 2 contacts as follows: "admin-c" (administrative contact) and "tech-c" (technical contact). They will be the network contacts, required to be listed by their nic-handles in certain RIPE Database objects. This is done for operational correspondence such as Network troubleshooting. The admin-c must be physically located at the site of the network. The tech-c does not need to be physically located at the site of the network.

STEP 1 A: Non-ECAC Users within the EUR Region shall contact the ICAO EUR/NAT Office using the template provided in Attachment B of this document to request an IPv6 address space allocation, including details for administrative and technical contacts as described in step 1 for ECAC Users.

STEP 1 B: For non-ECAC Users within the EUR Region, the ICAO EUR/NAT office will analyse the request and if legitimate will ask EUROCONTROL LIR to perform the IPv6 allocation process on their behalf. (STEP 2 to STEP 11)

STEP 1 C: The ICAO EUR/NAT Office will inform the non-ECAC Users within the EUR Region that their request will be further processed on their behalf by EUROCONTROL LIR.

STEP 2: EUROCONTROL registers the IPv6/42 allocation and the details of the corresponding administrative and technical contact into the RIPE database and indicates the address space as being ALLOCATED BY LIR.

STEP 3: EUROCONTROL assigns two /48 prefixes (one for real v6 nodes and the other to represent virtual v6 nodes) for operational networks and another two for pre-operational networks. They correspond to 2 values of the F2 field (Figure 1) complemented by the v4/v6 toggle bit.

STEP 4: EUROCONTROL registers this information into the RIPE database on behalf of the User. These 4 assignments are referred to as the "basic assignment".

*Note 2:* This process will provide the same address space to all organisations irrespective of their size. In reality, some organisations may be operating multiple, very large or regional networks. As a consequence, the basic assignment may be

insufficient or inappropriate. In such cases an alternative assignment can be made within the organisations range as long as it remains within the RIPE policy and does not compromise the overall addressing scheme.

STEP 5: EUROCONTROL informs the administrative and the technical contact of their: /42 IPv6 allocation and the registered contact information in the RIPE database.

STEP 6: EUROCONTROL informs the administrative and the technical contact of their 4 assignments registered in the RIPE database (see STEP 4). With the above assignments the organisation receives operational and pre-operational IPv6 address space and also operational and pre-operational IPv6 “virtual” address space for IPv4-only nodes that require a virtual IPv6 address assignment if IPv6/IPv4 network address translation (NAT-PT) is applied at "network" border.

STEP 7: For BGP peering with neighbours, EUROCONTROL informs the administrative and the technical contact of a Private AS number to be used to advertise their /42 allocation at their network border.

STEP 8: EUROCONTROL informs the ICAO EUR/NAT Office of the resolution of the IPv6 address space request for non-ECAC Users by means of returning the address space allocation request form populated with the appropriate details.

STEP 9: EUROCONTROL updates the latest version of the “EUROCONTROL LIR Network Address Assignments” ~~excel file~~ on the ~~IPv6 Resources SharePoint Repository~~[EIPR](#) on the EUROCONTROL extranet.

*Note 3:* The ~~EUROCONTROL IPv6 Resources SharePoint~~[EIPR](#) is a restricted access controlled Repository for administrative and technical contacts identified under STEP 1.

The updated information on the ~~EUROCONTROL IPv6 Resources SharePoint~~[Repository](#)[EIPR](#) takes precedence over Table 1 of Appendix A of this document.

STEP 10: Use of the inter-organisational address 2001:4B50:0040::/42 for direct connections between ANSPs must be requested by the respective administrative and technical contacts and allocated by EUROCONTROL LIR under STEP 1.

STEP 11: EUR ANSPs, FABs, pan-European and regional CSPs are responsible for the assignment of their ALLOCATED BY LIR address space to their End Users.

STEP 12: When the basic IPv6 address space assignment is inadequate, an addressing scheme should be co-ordinated with the EUROCONTROL LIR to ensure it is in line with RIPE policies and the overall addressing scheme. ECAC Users within the EUR Region will send requests to [ipv6@eurocontrol.int](mailto:ipv6@eurocontrol.int).

Non-ECAC Users within the EUR Region shall contact the ICAO EUR/NAT Office using the template provided in Attachment B of this document.

#### 5.2.1.2. IPv6 address space de-allocation

STEP 1D: ECAC users (States, ANSPs and other legitimate users such as FABs, pan-European and regional Communication Service Providers (CSPs) and the EUROCONTROL/Network Manager) can release a /42 IPv6 allocation if there are no

operational or pre-operational assignments within that /42 IPv6 allocation. Requests to be sent to [ipv6@eurocontrol.int](mailto:ipv6@eurocontrol.int).

STEP 1D A: Non-ECAC Users within the EUR Region shall contact the ICAO EUR/NAT Office using the template provided in Attachment B of this document to release an IPv6 address space allocation.

STEP 1D B: For non-ECAC Users within the EUR Region, the ICAO EUR/NAT office will analyse the request and if legitimate will ask EUROCONTROL LIR to perform the release of the respective IPv6 address space allocation on their behalf.

STEP 1D C: The ICAO EUR/NAT Office will inform the non-ECAC Users within the EUR Region that their request will be further processed on their behalf by EUROCONTROL LIR.

STEP 2D: EUROCONTROL informs the administrative and the technical contact of the released /42 IPv6 address space allocation.

STEP 3D A: In case the legitimate user's intention is to continue to use the Private AS number without a /42 IPv6 address space allocation, a clear statement shall be provided with the intended usage justification (network description, network type, configuration), in the relevant request of STEP 1D for ECAC users or STEP 1D A for non-ECAC users.

STEP 3D B1: In case the legitimate user does not intend to continue to use the Private AS number without a /42 IPv6 address space allocation, a clear statement shall be provided in the relevant request of STEP 1D for ECAC users or STEP 1D A for non-ECAC users.

STEP 3D B2: EUROCONTROL informs the administrative and the technical contact of their Private AS number release.

Note: In this case the Private AS number is available for being re-allocated to another legitimate user.

STEP 4D: EUROCONTROL de-registers the /42 IPv6 allocation and the details of the corresponding administrative and technical contact into the RIPE database and informs the corresponding administrative and technical contact of that. EUROCONTROL updates the latest version of the "EUROCONTROL LIR Network Address Assignments" ~~excel file~~ on the ~~IPv6 Resources SharePoint Repository~~[EIPR Assignments](#) on the EUROCONTROL extranet.



## **Attachment A – Change Control Mechanism of the EUR IPv6 address space allocation document**

A.0.1 The change control mechanism provides two categories:

- Defect Report (DR), and
- Change Proposal (CP)

A.0.2 Proposals to introduce changes to the EUR IPv6 address space allocation document itself may arise from users, implementers or manufactures.

A.0.3 The interested party should send any proposed change (CP or DR) of the EUR IPv6 address space allocation document to the EUR/NAT ICAO Regional Office. The Regional Office forwards the document to the Planning Group of AST TF for further processing.

A.0.4 The procedure for submission and processing of a Defect Report (DR) or a Change Proposal (CP) involves the following steps:

### **A.1 Procedure for Defect Report (DR)**

A.1.1 A problem is detected, which is reflected in the EUR IPv6 address space allocation document and may be attributed to implemented procedures and/or inconsistencies in the documentation.

A.1.2 The problem is reported to the Rapporteur of the Planning Group of AST TF, normally via the EUR/NAT ICAO Regional Office, by submission of a defect report (DR). A standard reporting format is used (see attached template in A.3).

A.1.3 The Rapporteur assigns a number and priority to the defect report and introduces it to the agenda of an upcoming meeting of the PG.

A.1.4 The PG evaluates the report and either adopts it as a working item or rejects it. The party, which submitted the change proposal, is notified accordingly.

A.1.5 Experts of the PG are assigned to the problem when adopted (Status: accepted) and milestone dates are set. Outside expertise may be invited to participate, as appropriate.

A.1.6 The PG develops proposals for resolving the problem and submits them to the AST TF for approval.

A.1.7 The AST TF approves or rejects the presented proposals. In case of the latter, the subject is referred back to the PG (step A.1.6) or discarded.

A.1.8 The PG drafts appropriate text for amendment of the EUR IPv6 address space allocation document and submits it to the AST TF for approval.

A.1.9 The AST TF approves or rejects the proposed material. In case of the latter, the subject is referred back to the PG (step A.1.8).

A.1.10 The proposed amendments to the EUR IPv6 address space allocation document are presented to the EASPG/PCG for approval.

A.1.11 Solutions are implemented.

*Note. — Steps A.1.6 and A.1.8 may run in parallel.*

## A.2 Procedure for Change Proposal

- A.2.1 The same structured procedure, with the exception of steps (A.1.6) and (A.1.7) applies in case of proposed enhancements to the EUR IPv6 address space allocation document or inconsistencies with relevant existing documentation.
- A.2.2 In this case, a change proposal (CP) should be submitted to the PG, normally via the EUR/NAT ICAO Regional Office. The format of the CP is similar to that of the DR.
- A.2.3 If ICAO SARPs and/or Technical Specifications are concerned, the change control process, set up by the ICAO Communications Panel and its Working groups, has to be followed by using appropriate procedures.

## A.3 Template for Defect Reports / Change Proposals

TEMPLATE FOR DEFECT REPORTS / CHANGE PROPOSALS	
<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px 10px;">DR IPV6AL_____</div> <div style="border: 1px solid black; padding: 2px 10px;">CP IPV6AL_____</div> </div>	
<b>Title:</b>	Short, indicative textual name
<b>Reference:</b>	Number assigned by the PG Rapporteur
<b>Originator reference:</b>	Provided by the originator
<b>Submission date:</b>	
<b>Submitting State/Organisation:</b>	
<b>Author:</b>	
<b>Contact Information:</b>	e-mail, fax, telephone and postal address
<b>Experts involved:</b>	
<b>Status:</b>	Assigned by the PG Rapporteur
<b>Priority:</b>	Assigned by the PG Rapporteur
<b>Document reference:</b>	Affected section(s) of the EUR IPv6 address space allocation document
<b>Description of defect:</b>	Nature of the problem in detail Reason(s) for requesting changes
<b>Assigned expert(s):</b>	
<b>Task history:</b>	Working Papers and Information Papers Produced on the subject

<b>Proposed solution:</b>	Including amendments to the text, if feasible
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<b>DR/CP STATUS control sheet</b>				
<b>Event</b>	<b>Date</b>	<b>Status</b>		<b>Remark</b>
DR or CP received submission date		Set to submitted		
discussion at PG/ ...		Set to accepted	Set to rejected	
Date for development of proposals/ solutions				Responsible:
discussion at PG/ ...		Set to resolved		
presentation to AST TF/ ...		Set to adopted	Set to rejected	
Date for development of amendment to the EUR IPv6 address space allocation document				Responsible:
discussion at PG/		Set to approved		
presentation to AST TF/ ...		Set to approved for application		
Additional DATES and comments				

**Attachment B – Non-ECAC Users within the EUR Region IPv6 address space allocation request or IPv6 address space de-allocation request (AR) template**

**Non-ECAC Users within the EUR Region  
IPv6 Address Space allocation or  
IPv6 Address Space de-allocation request (AR)**

<b>Reference:</b>	Number assigned by the ICAO EUR/NAT Office Focal Point
<b>Originator reference:</b>	Provided by the originator
<b>Submission date:</b>	
<b>Submitting State/Organisation:</b>	
<b>Contact Information:</b>	e-mail, fax, telephone and postal address
<b>Admin Contact in organisation</b>	e-mail, fax, telephone and postal address
<b>Technical Contact in organisation</b>	e-mail, fax, telephone and postal address
<b>Author:</b>	
<b>Status:</b>	
<b>Priority:</b>	Assigned by the ICAO EUR/NAT Office Focal Point
<b>Document reference:</b>	
<b>Kind of modification:</b>	<p>a) New request or additional space request.</p> <p>b) Address space de-allocation request, followed by either statement b1 or b2:</p> <p style="padding-left: 40px;"><b>b1)</b> continue using the Private AS number, <b>with justification</b></p> <p style="padding-left: 40px;"><b>b2)</b> stop using Private AS number</p>
<b>Proposed applicability date for the allocation:</b>	
<b>Description of the modification:</b>	<p>Nature of the request in detail</p> <p>Reason(s) for request</p>
<b>History:</b>	Related Papers produced and tasks performed on the subject

<b>Eligibility decision</b>	Status assigned by the ICAO EUR/NAT Office Focal Point
<b>Address Space allocation status</b>	Assigned by EUROCONTROL LIR

<b>AR STATUS control sheet</b>				
<b>Event</b>	<b>Date</b>	<b>Status</b>		<b>Remark</b>
AR received submission date		Set to submitted		
Eligibility decision		Set to accepted	Set to rejected	Responsible: ICAO EUR/NAT Office
Inform User and ask EUROCONTROL LIR to perform the IPv6 address space allocation / de-allocation				Responsible: ICAO EUR/NAT Office
Date for development of proposals/ solutions				Responsible: EUROCONTROL LIR
IPv6 address space allocation/de-allocation status/ ...		Allocated by LIR Registered by LIR	Set to rejected	Responsible: EUROCONTROL LIR
		De-allocated by LIR		
IPv6 address space request resolution/ ...		Set to resolved		Responsible: EUROCONTROL LIR
Inform User and ICAO EUR/NAT Office				Responsible: EUROCONTROL LIR
Additional DATES and comments				

**END of document**

## **Appendix A: EUR IPv6 Address allocation**

### **Table 1 – EUROCONTROL LIR allocation plan**

The latest version of the “EUROCONTROL LIR Network Address Assignments” ~~excel~~-file is available on the ~~IPv6 Resources SharePoint Repository on the EUROCONTROL extranet~~[EIPR Assignments Overview page, https://ext.eurocontrol.int/eipr/ipv6/assignments/overview](https://ext.eurocontrol.int/eipr/ipv6/assignments/overview). The updated information on ~~SharePoint Repository~~[EIPR](https://ext.eurocontrol.int/eipr/ipv6/assignments/overview) takes precedence over Table 1 of Appendix A.

It is recommended to annually update Appendix A of this document to reflect the latest version of the EUROCONTROL LIR IPv6 allocation Plan.

*Note 1. — Appendix A is provided to the ICAO EUR/NAT Office and it is intended to be updated on annual basis. However, due to security concerns its distribution will be limited and under strict control of ICAO and EUROCONTROL*

*Note 2. — A complete list of the EUR IPv6 address space allocation requests processed (pending, resolved, rejected) is presented to AST TF on annual basis by EUROCONTROL.*

**END of Appendix A**