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**U.S. Department of Transportation  
Federal Aviation Administration**

**Standard Practice**

**NATIONAL AIRSPACE SYSTEM (NAS)  
NAMING AND ADDRESSING STRUCTURE FOR GROUND-TO-  
GROUND COMMUNICATION**

**A. Approved for public release; distribution is unlimited**

## **FOREWORD**

This standard establishes a naming and addressing structure for ground-to-ground communication within the National Airspace System (NAS). A well-defined naming and addressing structure is required to ensure interoperability of NAS systems and efficient operation, maintenance, and administration for internal and external users.

This document was prepared in accordance with FAA-STD-005e.

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# **1 SCOPE**

This standard establishes the naming and addressing standards that should be supported in the Federal Aviation Administration (FAA) National Airspace System (NAS) data communications infrastructure, including end systems, local area networks (LAN), and wide area networks (WAN).

This standard specifies the available procedures and industry-accepted practices that must be used to implement a minimum subset to ensure NAS system interoperability. The minimum set defined in this document may exceed the minimum requirements for a particular program or project.

Naming and addressing practices in this standard are consistent with FAA-STD-039c and ICAO Doc. 9705 Ed. 3 and ICAO Doc. 9739.

## **1.1 Purpose**

This standard defines a comprehensive structure for naming and addressing within the NAS.

## 2 APPLICABLE DOCUMENTS

### 2.1 Government Documents

The following government documents form a part of this standard. If there is a conflict between these documents and the standard, the standard shall supersede the documents.

FAA-STD-005e	Preparation of Specifications, Standards and Handbooks, 1996
FAA-STD-039c	NAS Open System Architecture and Protocols, August 2003
NAS1370.500.4	NAS Operations Internet Protocol Version 4 (IPv4) Address Assignment Plan, May 2004

### 2.2 Non-Government Documents

The following non-government documents form a part of this standard. If there is a conflict between these documents and the standard, the standard shall supersede the documents.

#### Internet Standards

RFC-791	Internet Protocol, September 1981
RFC-826	An Ethernet Address Resolution Protocol-- or --Converting Network Protocol Addresses to 48.bit Ethernet Address for Transmission on Ethernet Hardware, November 1982
RFC-903	A Reverse Address Resolution Protocol, June 1984
RFC-950	Internet Standard Subnetting Procedure, August 1985
RFC-1518	An Architecture for IP Address Allocation with CIDR, September 1993
RFC1519	Classless Inter-Domain Routing (CIDR): an Address Assignment and Aggregation Strategy, September 1993
RFC-1591	Domain Name System Structure and Delegation, 1994
RFC-1887	An Architecture for IPv6 Unicast Address Allocation, December 1995
RFC-1888	OSI NSAPs and IPv6, August 1996
RFC-1918	Address Allocation for Private Internets, February 1996

RFC-2050	Internet Registry IP Allocation Guidelines, November 1996
RFC-2131	Dynamic Host Configuration Protocol, March 1997
RFC-2375	IPv6 Multicast Address Assignments, July 1998
RFC-2450	Proposed TLA and NLA Assignment Rules, December 1998
RFC-2460	Internet Protocol, Version 6 (IPv6) Specification, December 1998
RFC-2462	IPv6 Stateless Address Autoconfiguration, December 1999
RFC-2473	Generic Packet Tunneling in IPv6 Specification, December 1998
RFC-2526	Reserved IPv6 Subnet Anycast Addresses, March 1999
RFC-2732	Format for Literal IPv6 Addresses in URL's, December 1999
RFC-2928	Initial IPv6 Sub-TLA ID Assignments, September 2000
RFC-3022	Traditional IP Network Address Translator (Traditional NAT), January 2001
RFC-3041	Privacy Extensions for Stateless Address Autoconfiguration in IPv6, January 2001
RFC-3056	Connection of IPv6 Domains via IPv4 Clouds without Explicit Tunnels, February 2001
RFC-3177	IAB/IESG Recommendations on IPv6 Address Allocations to Sites, September 2001
RFC-3315	Dynamic Host Configuration Protocol for IPv6 (DHCPv6), July 2003
RFC-3363	Representing Internet Protocol version 6 (IPv6) Addresses in the Domain Name System (DNS), August 2002
RFC-3484	Default Address Selection for Internet Protocol version 6 (IPv6), February 2003
RFC-3513	Internet Protocol Version 6 (IPv6) Addressing Architecture, April 2003
RFC-3596	DNS Extensions to Support IP Version 6, October 2003

## **ISO/IEC**

ISO/IEC 8802-11 Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements -- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: 1999

ISO/IEC 15802-1 Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Common specifications -- Part 1: Medium Access Control (MAC) service definition: 1995

## **2.3 Other Publications**

ICAO ATN Doc. 9705 Edition 3 Profile Requirement List ISO-8571-5: File Transfer, Access, and Management – Part: Protocol Implementation Conformance Statement (PICS) Proforma

ICAO Doc. 9739 Comprehensive Aeronautical Telecommunication Network (ATN) Manual

## **2.4 Document Sources**

To obtain copies of applicable documents or standards, contact the appropriate organizations.

### **FAA documents**

Copies of FAA specifications, standards, and publications may be obtained from the Contracting Officer, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, DC, 20591. Requests should clearly identify the material by number and date as well as state the intended use of the material.

### **Non-Government Documents**

Copies of Requests for Comments (RFC) may be obtained from the Internet Engineering Task Force Web site at [www.ietf.org](http://www.ietf.org).

Copies of standards of the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) may be obtained from [www.iso.org](http://www.iso.org).

### **Other Publications**

Copies of papers from the International Civil Aviation Organization (ICAO) may be obtained from [www.icao.int](http://www.icao.int).

### 3 DEFINITIONS AND ACRONYMS

#### 3.1 Acronyms

ARP	Address Resolution Protocol
ATN	Aeronautical Telecommunication Network
CIDR	Classless Interdomain Routing
CLNP	Connectionless Network Protocol
DHCP	Dynamic Host Configuration Protocol
DHCPv6	Dynamic Host Configuration Protocol for IPv6
DNS	Domain Name System
FAA	Federal Aviation Administration
ICAO	International Civil Aviation Organization
ICD	Interface Control Document
IP	Internet Protocol
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
IRD	Interface Requirements Document
ISO/IEC	International Organization for Standardization/International Electrotechnical Commission
ISP	Internet Service Provider
LAN	Local Access Network
MAC	Medium Access Control
NAPT	Network Address Port Translation
NAS	National Airspace System



NAT	Network Address Translation
NLA	Next-Level Aggregator
NSAP	Network Service Access Point
OSI	Open System Interconnection
PAT	Port Address Translation
PHY	Physical Layer
PICS	Protocol Implementation Conformance Statement
RARP	Reverse Address Resolution Protocol
RFC	Requests for Comments
TCP	Transport Control Protocol
TLA	Top-Level Aggregation
UDP	User Datagram Protocol
URL	Uniform Resource Locator

## 3.2 Definitions

CIDR	CIDR is an IP addressing concept based on route aggregation. Blocks of network addresses are grouped in binary (or power of two) groups using network masks. In this way, large groups of addresses can be represented in network routing tables as a single entry. This also yields management efficiencies regarding security, accounting, and other network management activities. Within the context of a network segment, each of these large groups can then be subdivided along binary boundaries into smaller groups. The smaller groups then can be allocated throughout the network segment and can even impact the way allocations are made on individual LANs.
DNS	The Domain Name System (DNS) is the method by which Internet addresses in mnemonic form, such as <code>www.faa.gov</code> , are converted into the equivalent numeric IP address, such as <code>134.1.12.1</code> (NOTE: This is not the actual IP address associated with <code>www.faa.gov</code> .) To the user and application process, this translation is a service provided either by the local host or from a remote host via the Internet. The DNS server (or

resolver) may communicate with other Internet DNS servers if it cannot translate the address itself.

## NAT

A mechanism for reducing the need for globally unique IP addresses. NAT allows an organization with addresses that are not globally unique to connect to the Internet by translating those addresses into globally routable address space. Hiding of internal addresses to the outside world can be used as a security feature.

## 4 GENERAL REQUIREMENTS

This section specifies general requirements for implementing naming and addressing practices within NAS networks and end-systems. This standard's practices are based on the Internet Protocol Suite architecture, as described in FAA-STD-039c, which includes Application, Transport, Network, Link, and Physical Layers. Figure 1 shows the link between naming and addressing practices across the OSI model.

OSI Model	IPv4	IPv6 (Optional)
Application Layer	DHCP      DNS	DHCP      DNS Browser (URL)
Transport Layer (TCP/UDP)	(not applicable)	
Network Layer (IP)	NAT      NAPT Subnetting      CIDR	Address autoconfiguration
Data Link Layer	ARP	RARP
Physical Layer	(not applicable )	

**Figure 1 Naming and Addressing Practices**

### 4.1 Application Layer Naming and Addressing Requirements

Using the Domain Name System (DNS) and Dynamic Host Configuration Protocol (DHCP) simplifies naming and addressing at the application layer. The DNS makes using the Internet easier because it allows use of a familiar string of letters (the "domain name") instead of the IP address. The DHCP automates the configuration of computers that use IP. The DHCP can be used to automatically assign IP addresses, to deliver stack configuration parameters such as the subnet mask and default router.

Section 5.1 contains detailed requirements for application layer naming and addressing are.

### 4.2 Transport Layer Addressing Requirements

The transport layer has no requirements for naming and addressing. Any project requirements for naming and addressing at this layer should in accordance with project (Interface Requirements Documents and Interface Control Documents).

### **4.3 Network Layer Addressing Requirements**

This document covers both IPv4 and IPv6 network layer addressing. Currently, IPv6 is not implemented in any part of the NAS network, but IPv6 is a natural replacement for IPv4 in the future. IPv4 address space is limited to a 32-bit address field, which supports only 4 billion (4,294,967,296) unique addresses, one-fourth of which were allocated by 1994. Since then, several technical solutions—like Classless Interdomain Routing, Subnetting, NAT, and port address translation (PAT)—were developed to combat IPv4 address exhaustion. These techniques only slowed down the rate at which IPv4 addresses were allocated, but the problem of address exhaustion still remains. This is why IPv6 was developed. It has a 128-bit address field that allows for  $3.4 \times 10^{38}$  addresses. IPv6-based networks are already operating in parts of the world and eventually will be operating within the NAS. Therefore, this document covers both IPv4 and IPv6 network layer addressing.

Section 5.3 contains detailed requirements for network layer addressing.

### **4.4 Link Layer Addressing Requirements**

General requirements for Link Layer Addressing include use of Reverse Address Resolution Protocol (RARP) and Address Resolution Protocol (ARP). RARP translates hardware interface addresses to protocol addresses. ARP translates the IP address to a hardware interface address.

Section 5.4 contains detailed requirements for network layer addressing.

### **4.5 Physical Layer Addressing Requirements**

The physical layer has no requirements for naming and addressing.

## **5 DETAILED REQUIREMENTS**

This section describes the detailed naming and addressing requirements for the IP networks.

Naming and addressing requirements for the Aeronautical Telecommunication Network (ATN) interfaces and domestic X.25 interfaces shall be implemented in accordance with ICAO Doc. 9705, Ed. 3, Subvolume VIII and ICAO Doc. 9739 and Appendix A of this document.

### **5.1 Application Layer Naming and Addressing Detailed Requirements**

#### **5.1.1 Domain Name Systems**

The DNS for IPv4 shall be implemented in accordance with RFC-1591.

DNS implementation for IPv6 is optional. The DNS for IPv6 shall be implemented in accordance with RFC-3363 and RFC-3596.

#### **5.1.2 Dynamic Host Configuration Protocol**

The DHCP for IPv4 shall be implemented in accordance with RFC-2131.

DHCP implementation for IPv6 is optional. The DHCP for IPv6 shall be implemented in accordance with RFC-3315.

#### **5.1.3 Browser**

Browser IPv6 address representation is optional. IPv6 addresses representation shall be in accordance with RFC-2732 when used in an Internet browser.

#### **5.1.4 Port Assignment**

Port assignment shall be implemented in accordance with Internet Assigned Numbers Authority policies, which can be found at <http://www.iana.org/assignments/port-numbers>.

#### **5.1.5 Port Address Translation**

PAT or Network Address Port Translations (NAPT) should be implemented in accordance with RFC-3022.

### **5.2 Transport Layer Addressing Detailed Requirements**

Transport layer addressing requirements are not within the scope of this standard.

### **5.3 Network Layer Addressing Detailed Requirements**

#### **5.3.1 IP version 4**

IPv4 addressing should be implemented in accordance with RFC-791.

#### 5.3.1.1 Address Allocation

A distinction is usually made between address allocation and address assignment, and this document makes the distinction. Internet service providers (ISP) are “allocated” address space, while end users are “assigned” address space.

IPv4 address allocation shall be in accordance with RFC-2050.

#### 5.3.1.2 Address Assignment

A distinction is usually made between address allocation and address assignment, and this document makes the distinction. ISPs are “allocated” address space, while end users are “assigned” address space.

Private IPv4 addresses shall be assigned in accordance with RFC-1918 and the latest version of NAS1370-500.4.

#### 5.3.1.3 Network Address Translation

NAT should be implemented in accordance with RFC-3022.

#### 5.3.1.4 Subnetting

Address subnetting shall be implemented in accordance with RFC-950.

#### 5.3.1.5 Classless Interdomain Routing

CIDR addresses shall be implemented in accordance with RFC-1518 and RFC-1519.

### 5.3.2 IP version 6 (Optional)

IPv6 (RFC-2460) addressing shall be implemented in accordance with RFC-3513.

#### 5.3.2.1 Address Allocation

A distinction is usually made between address allocation and address assignment, and this document makes the distinction. ISPs are “allocated” address space, while end users are “assigned” address space.

Address allocation for IPv6 addresses shall be implemented in conformance with policy of the American Registry for Internet Numbers, which can be found at [http://www.arin.net/policy/ipv6\\_policy.html](http://www.arin.net/policy/ipv6_policy.html).

#### 5.3.2.2 Address Assignment

IPv6 address assignment shall be done in accordance with RFC-2450 and RFC-2928 and RFC-3177.

#### 5.3.2.3 Unicast Address Assignment

IPv6 Unicast Address Assignment shall be done in accordance with RFC-1887.

#### 5.3.2.4 Anycast Address Assignment

IPv6 Anycast Address Assignment shall be done in accordance with RFC-2526.

#### 5.3.2.5 Multicast Address Assignment

IPv6 Multicast address assignment shall be in accordance with RFC-2375.

#### 5.3.2.6 Address Autoconfiguration

IPv6 address autoconfiguration shall be done in accordance with RFC-2462 and RFC-3041.

### **5.4 Link Layer Addressing Detailed Requirements**

#### **5.4.1 Reverse Address Resolution Protocol and Address Resolution Protocol**

RARP shall be implemented in accordance with RFC-903.

ARP shall be implemented in accordance with RFC-826.

### **5.5 Physical Layer Addressing Detailed Requirements**

Physical layer addressing requirements are not within the scope of this standard.

## **6 NOTES**

### **6.1 “6 to 4” (Optional)**

During the transition from IPv4 to IPv6 networks, IPv6 sites need to communicate with each other over the IPv4 network without explicit tunnel setup, and to communicate with native IPv6 domains via relay routers. To accomplish this, the IPv6 address needs to be converted to an IPv4 address.

IPv6 to IPv4 address conversion shall be done in accordance with RFC-3056.

### **6.2 Mapping ATN NSAPA and IPv6 Address (Optional)**

Mapping ATN NSAPA to the IPv6 address shall be in accordance with RFC-1888.

### **6.3 Encapsulating ATN CLNP over IPv6 Infrastructure (Optional)**

Encapsulating ATN packets over an IPv6-based network shall be done in accordance with RFC-2473.

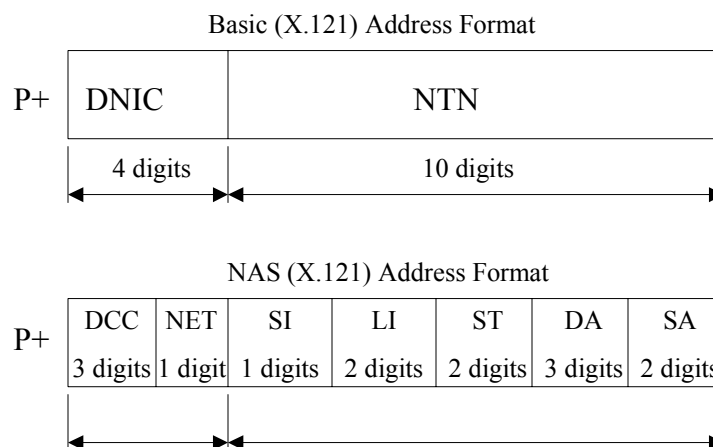


## APPENDIX A

### X.121 Address Format

The X.121 address attribute type value shall use numeric string syntax and have a length of 14 decimal digits. The X.121 address may contain an international prefix (P), which shall use numeric string syntax and have a length of one decimal digit.

The address format shall be consistent with the CCITT-X.121, as shown in the Figure 1. It shall consist of a single decimal digit international prefix (P) and 14 decimal digit address. The address shall have two basic parts, the data network identification code (DNIC) and the network termination number (NTN). The international Prefix shall only be used for a call being made to an open system connected to a public data network in a different country.



**Figure 1 X.121 Address Format**

### DNIC

The DNIC shall be four decimal digits in length consisting of digits 1-4. Digit 1 shall be used to indicate world zones such as North America, Europe, etc. Together, 1-3 digits shall specify the data country code (DCC) as defined in CCTITT X.121, providing identification of the country, pr geographical area. The digit 4 shall be used to specify the network identification number (NID).

## NTN

The NTN shall be 10 decimal digits in length. It shall consist of the subnetwork identifier (SI), location identifier (LI), system type (ST), device address (DA), and sub-address (SA).

The subnetwork identifier shall be one decimal digit in length. It shall be used to identify the subnetwork of a system. There are only two accepted SI values. SI value of 0 is used for NADIN PSN, and SI value of 1 is reserved.

The location identifier shall be two decimal digits in length. It shall be used to identify the physical location of the open system. The following are accepted LI values:

- 1 – ZAB – Albuquerque
- 2 – ZAN – Anchorage
- 3 – ZTL – Atlanta
- 4 – ZBW – Boston
- 5 – ZAU – Chicago
- 6 – ZOB – Cleveland
- 7 – ZDV – Denver
- 8 – ZFW – Fort Worth
- 9 – ZHN – Honolulu
- 10 – ZHU – Houston
- 11 – ZID – Indianapolis
- 12 – ZJX – Jacksonville
- 13 – ZKC – Kansas City
- 14 – ZLA – Los Angeles
- 15 – ZME – Memphis
- 16 – ZMA – Miami
- 17 – ZMP – Minneapolis
- 18 – ZNY – New York
- 19 – ZLI – Long Island
- 20 – ZOA – Oakland
- 21 – ZLC – Salt Lake City
- 22 – ZSE – Seattle
- 23 – ZDC – Washington
- 24 – OEX – Aeronautical Center
- 25 – ACY – FAA Technical Center
- 26 – ATL – Atlanta NAWPF
- 27 – SLC – Salt Lake NAWPF
- 28 – DC05 FAA Headquarters – FOB 1-A 800 Independence Ave. S.W., Washington DC

The system type shall be two decimal digits in length. It shall be used to identify the system or device type. The following are accepted ST values:

- 1 – ACCC
- 2 – ADAS
- 3 – AATS
- 4 – AWP
- 5 – CFMWP
- 6 - CNSP
- 7 – DLP
- 8 – DUAT SERVICE
- 9 - FSDPS
- 10 – LABS
- 11 – NMCE
- 12 – MPS
- 13 – MWP
- 14 – RWP
- 15 – TMP
- 16 – VSCS
- 17 – WMSCR
- 18 – NADIN PSN/MSN Gateway
- 19 – NADIN PSN NCC

The device address shall be two decimal digits in length. Is shall be used to specify the port number representing the open system's logical connectivity to NADIN PSN.

The sub-address shall be two decimal digits in length. It shall be used to specify the sub-port number (i.e., packet assembler/ disassembler port) representing the system's or device's logical connection to the NADIN PSN.