# Take the Next Step with the Next Generation Protocol


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This document describes an idea for use of IPv6 over the amateur radio. IPv6 has huge address space and it supports realtime traffic. IPv6 realize new applications. For example, managing IPv4 address is not easy. It is possible to encode our "call sign" into IPv6 address. It enables us to managing IPaddress much easier.

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1. What's IPv6

IPv6 is a next generatin of IP. IP is a inter networking protocol used in all over the world. Since the IP we are using today is version four, the current version of IP often called IPv4.

1.1. What the IPv6 Has Advateges of

The most important advantage in IPv6 is its design concept. That is,

Keep Concept

IPv6 keeps good concept in IPv4. This policy is based on the fact that IPv4 has been a major player on the Internet for more than two decades. IPv6 specification is fixed by deleting groundless spec, not used spec in IPv4, keeping good spec and bringing in new idea. And, IPv6 header format was simplified and became easy to implement.

Extended address space besed on statistical estimation

The new address space is set to be large enough to connect 1000 trillion computers through one trillion networks.

The huge address space of IPv6 gives much deeply hierarchical address structure instead of only three layers on IPv4. And the huge space gives quite new address usages.

Careful Planning of address assignment

The meaning of any part of the adress space will be dicussed and agreed before practical use. Many address regions are reserved for future use. These reserved addresses are used not only when it faces the address shortage but also when new idea of address use is introduced.

1.2. Simplified Header Format

The header format of IPv6 is simplified. Here is the list of interesting changes in header fields.

version field

The very first 4bits are verion field as same as IPv4. Their contents are no longer important becouse IP version is identified by link layer protocol instead of this field.

priority value

The next 4bits indicate priority. This field is used to support realtime traffic.

flow label

Newly added field. This field is used to suport realtime traffic.

payload length

The total length field in IPv4 is replaced by pay load length field. The pay load length holds the length of "payload data" in the packet. The pay load length isn't including header's length. In othre words, subtracting header's length from total length gives payload length.

next header

One or more extention headers may follow the first header. Next header is identifier of nearest trailing extentional header.

hop limit

Same as time to live (TTL) in IPv4 but the ditails of specifications are simplified.

The fields for header length, type of service, identification, flag, flagment offset, header checksum are ommited. Considering experience in IPv4, these fields are redundant and waste in routers and rarely used efficiency.

1.3. Extention Header

IPv6 can handle variouse optional information on consystent system. Several kind of extention headers are already defined for routing, authentication and security. The option field in IPv4 is absolutly redesigned. Today, option field in IPv4 is rarely used.

1.4. Extended Address Space

The systematic use of huge address space is main concept of IPv6.

IPv6 has 128bit address space. The first 10bits are defined to categorize the address regions. They are categorized on meaning of address region. Other hand, IPv4 address is devided only by size of address region.

**1.5.** Realtime Support

IPv6 supports the realtime traffic by effective use of flow label and priority. The supporting realtime of IPv6 is based on “fair queuing” mechanism.

Normaly, router has only one queue par interface. The packets arrived at the router are always put into the last of queue. The packet arrived first reaves the router first. The order of packets is never changed. In fair queuing, router has two or more queue par interface. Each queue has own priority. The packets arrived at the router are put into certain queue matching priority of each packet. The router processes the queues to satisfy priority of each queue. This meens that the higher priority packets reave the router more quickly.

IPv6 router defines queue the packet to be put in by priority and flow label in packet header.

Some router partly supports realtime traffic on IPv4. However, IPv6 router gives much better support.

1.6. What Isn’t IPv6

IPv6 is:

- Not a “rich” IP
- Not a “light waight” IP

Unfortunately, you would not get any interesting effects if you replace IPv4 by IPv6 on the intranet in your offece. Because IPv4 has enough ability to handle usual intranet requirements. So, why IPv6?

## 2. Why IPv6?

### 2.1. IPv6 Targets Exciting Applications

The diffreence between IPv4 and IPv6 is their target application. IPv4 has been used to connect computer-based applications. Compared to this, IPv6 will connect "everything," like phones, sensors, handy tools, and others.

The realtime applications will change their network platform from IPv4 to IPv6. Because the applicatins target commonplace person, not computer mania, who like to use more stylish tools to access their applications. Much more number of tiny goods are likely to be IPv6 node becouse IPv6 has huge address space.

IPv6 realizes the mobile networking using IP handover. The IP handover is new technique to change IP address of specific node without disconnecting TCP session. It is like handover among mobile phone base stations. This handovvver feature is not provided in IPv4.

IPv6 is expected to be common inter connection technology used in every field includes home automation, industrial monitoring, mobile phone, education and much more.

### 2.2. IPv6 Supports Realtime Traffic

the world wide web is a "cllasical" application today. More attractive voice and moving picture realtime application is drawing people.

Some important technical elements to make highspeed and flexible radio data link have been developed in amateur radio.

### 2.3. IPv6 Can Automate the Address Management

Most important problem for us in IPv4 is the address management. The IPv4 addrsss is managed by human. It is defficult to manage the address automaticaly on IPv4. IPv6 can solves this problem. Their addresss of netowrk protocol must be unique each other. Getting unique address without centrerlize adminstaratin is difficult.

It is pretty nice idea to map specific identifier which is alrady managed and not to conflict each other into IP address by one-to-one translation. It enable us getting unique IP address without new addresss administration.

We have "call signs" of radio stations and they are unique each other among all over thte world. IPv6 has enough address space to hold our call sign after mapping. Compared to this, no enough bits are left for optimize routing if the call sign is put int IPv4 address space. Because the name space of call sign is about as large as IPv4 address space.

Also IPv6 provides something other plug and play fueature. For example, IPv6 node can completely initialize itself with getting temporaly IPv6 address automaticaly using Ethernet pysical address.

IPv6 is easy to use. IPv6 has great possibiility of various new applications. IPv6 will give you absolutly new world. So why not IPv6?

## 3. Address Mapping

This section describes an idea of mapping call sign to IPv6 address one-to-one.

Our call sign consists of number digit and alphabet. Single letter of the call **sign is to** be encoded into one six bit binary integer.

Here is the tarnslation table between letters of call sign and integer.

```
call sign letter | integer
-----------------+---------
      " "        |   0
      "0"        |   1
      "1"        |   2
      ...        |  ...
      "9"        |  10
      "A"        |  11
      "B"        |  12
      ...        |  ...
      "Y"        |  35
      "Z"        |  36
   reserved      |  37
      ...        |  ...
   reserved      |  63
```

The call sign is tarnslaged into an array of six bit binaryes, reveresed, and put in IPv6 address. The reaseon of reversing alignment of the encoded call sign letter will be discussed later.

Here is an example figure of IPv6 address. The encoded call sign is "7L4FEP", which is my call sign.

```
                     1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 3 3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  reserved for network prefix                                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  reserved for network prefix                                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  reserved (1)              |    "P"    |"E"|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
  "E" |    "F"    |    "4"    |    "L"    |    "7"    |  (2)  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

(1) reserved for network prefix or call sign extention. (2) host address space

The last 4bits are used for host address. Each radio station is able to have at most 14 hosts directly connected to forein world.

The first 64bits are reserved for network prefix. For the present, some fixed bit pattern is assigned.

The bits from $64^{th}$ to $87^{th}$ are reserved for future use. It should be zero. If the length of call sign is extened from six letters to seven letters, the bits from 82th to $87^{th}$ are used fo extended letter. If the network prefix has to be longer, the bits from $64^{th}$ to 81th are used. If it has to be much longer, the bits from 82th to $87^{th}$ are used. Then, these bits became unusable for call sign extention.

On other words, the encodes call sign grows tail to head and the network prefix grows head to tail. That is the reason of reversing alignment of the encoded call sign letter.

## 4. IPv6 Implementations and Ported Application Programs

Many of software platforms like Linux and BSD are going to support IPv6 today. Major internet application programs are already compatible with IPv6. Refer to this URL to get useful information about IPv6.

http://www.terra.net/ipv6/ <http://www.terra.net/ipv6/>

Recent version of Linux kernel already supports IPv6 and fair queueing. I confirmed it by linux-2.1.115. See this page.

http://www.kernel.org/ <http://www.kernel.org/>

ftp://ftp.kernel.org/ <ftp://ftp.kernel.org/>

There is the project to implement IPv6 stack to FreeBSD. See this page.

http://www.kame.net/ <http://www.kame.net/>

WIDE IPv6 working group.

http://www.v6.wide.ad.jp/ <http://www.v6.wide.ad.jp/>

## 5. Conclusion

It gives us much merit makeing amateur radio network on IPv6 with address mapping method described here.

Specific applicatin to use IPv6 in amateur radio is under development.

We need some skills to use IPv6 now becouse software platform like Linux is no stable when used with IPv6 today. But soon it will be easier on amateur radio to use IPv6. Net work newcomer will enjoy data communication on amateur radio.

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# Half-Duplex Spread Spectrum Networks

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***ABSTRACT:***
This paper is a response to the presentation of the TAPR SS Modem at the 1997 Digital Communications Conference in Baltimore, MD. At this conference, topology's were proposed for use of the SS radios and modems in a network, which the author of this paper feels are rather limiting. This paper proposes to extend the topology's available allowing implementation of a network rather than a collection of communicating nodes. This paper also builds on a number of ideas brought up in the authors undergraduate thesis.

## *Introduction*

Expansion of radio based networks in amateur radio is process that is tied deeply to the technology used on the network. Packet radio links using FM radios succeeded because of the ability to incrementaly expand the network. To add another link, all that was needed was the hardware at the far end to be installed. In most cases, the link could be using existing hardware sharing time with existing links.

Put another way, amateurs find it much easier to set up one new station that two. This is especially the case when the equipment required for each station is quite expensive. This paper attempts to put the idea that a Spread Spectrum (SS) network can be designed to operate in a way that allows easy ad-hoc expansion. This paper addresses many of the problems seen in the protocols proposed for the forthcoming TAPR SS Radio.

## *Assumptions.*

There are several basic assumptions made in this paper about the operation of the TAPR SS Radios:

- The system transmits data in 'TIMESLOTS' which are on a particular frequency for a particular period of time. During a timeslot, the frequency of the station does not change. After each timeslot, the frequency in use changes.
- That radios transmit in equal length timeslots - regardless of the amount of information to be transmitted.