Digitalization Technology Standard for Amateur Radio

D-STAR

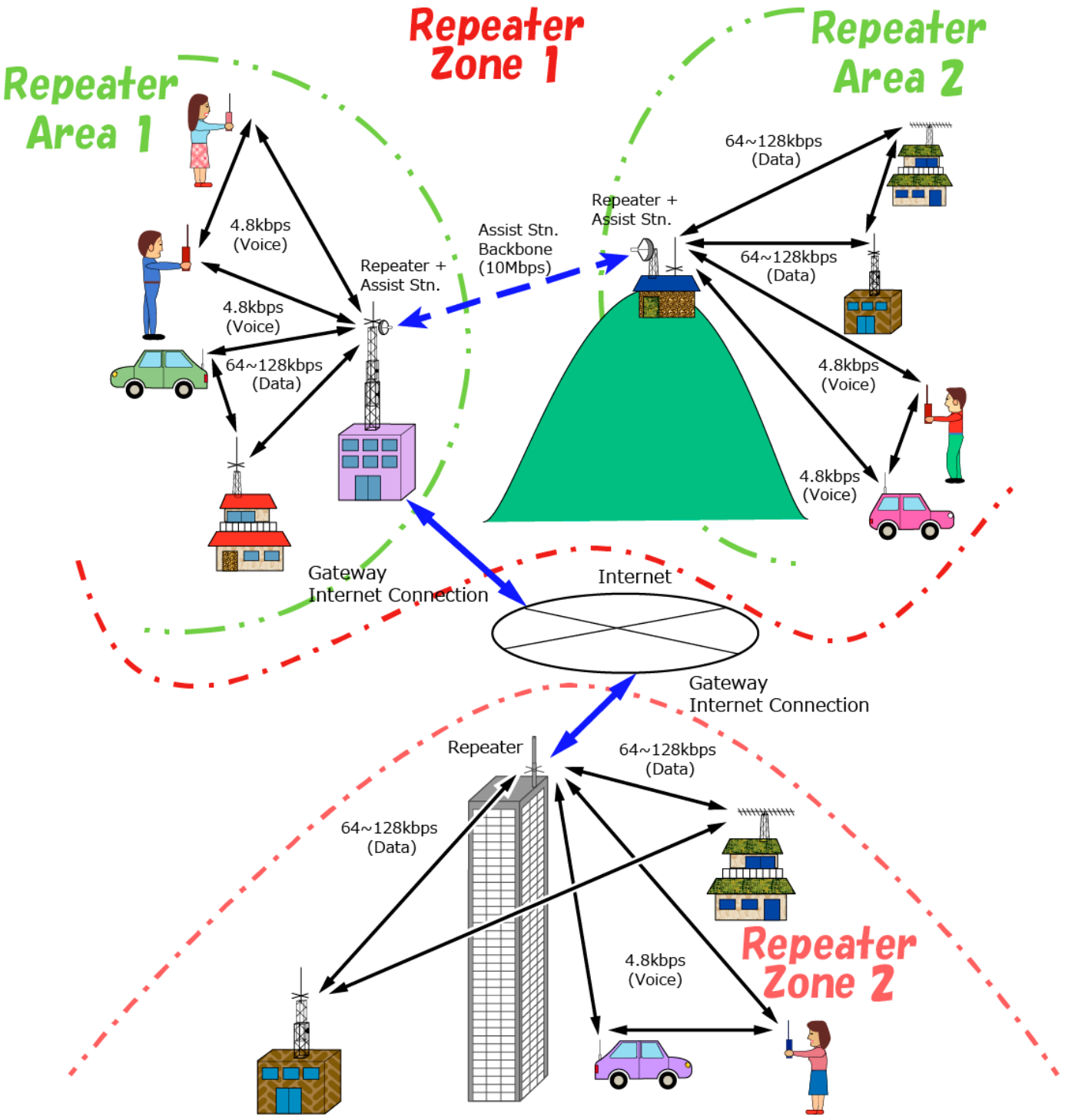
(Digital Smart Technologies for Amateur Radio)

The Japan Amateur Radio League, Inc

Preface

This document defines the standard method of digitalization technology for amateur radio. However, it can be revised and added as the technology progresses.

A simple diagram of the amateur radio digital system is shown below. This standard also applies to communications that do not use repeater stations, with the exception of content about relaying.



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Description of this Document

(1) The example callsigns in this document, except for the JARL club stations, are shown as "J$n***", which have no possibility of assignment. ($ = alphabet, n = number, * = alphabet)

(2) Half-width spaces are indicated with a "_" for clarity.

Note: These documents are applicable under Japanese law, and are added here for reference only to align with the original Japanese version of this document.

Revision History

September 2003	Provisional version released (Ver. 4.3)
December 2003	Additions and corrections (Ver. 4.3b)
March 2004	Full revision (Ver. 4.3c)
August 2014	Definition of data frame, definition of fast data, addition of CRC and transmission order of bit strings (Ver. 5.0)
September 2014	Changed the position of the "mitigation" byte in the "data block assembly details for frames containing Sync" and "data block assembly details for frames not containing Sync". Corrected inconsistency in terminology (unified segment to frame) (Ver. 5.0a)
October 2015	Corrected block number in message function (Ver. 5.0b)
February 2016	Corrected an error in the description of the zone in the figure in the "Preface". Since there are compatible modes other than AMBE-2020 for voice coding, the description was changed to acknowledge them. (Ver. 5.0c)
January 2019	Changed the description of "Chapter 5 Network Configuration Requirements" and changed the interface specification for interoperability with other networks (Ver. 6.0a).

Chapter 1 General Information

1.1 Scope of Application

The D-STAR (Digital Smart Technologies for Amateur Radio) system, which is the standard format for digitalization of amateur radio, consists of “transmitter/receiver equipment", "repeater equipment", "radio equipment for assist stations", and "network-related equipment".

This document specifies the technical requirements for this radio equipment. In addition, since this system uses assist stations and the Internet to communicate via multiple repeater devices, the software that controls the relaying also plays an important role, and therefore the outline of the communication protocol is also specified. In addition, if a law or other regulation specifies an identical item as the content of this document, the law or other regulation shall take precedence.

1.2 Applicable Documents

(1) Radio Act
(2) Cabinet Order
(3) Ordinance of the Ministry of Internal Affairs and Communications (Ordinance of the Ministry of Posts and Telecommunications before 2000) Ordinance for; Enforcement of the Radio Act, Radio Equipment Regulations
(4) Ministry of Internal Affairs and Communications Public Notice (Ministry of Posts and Telecommunications Public Notice before 2000)
(5) Radio Act related examination standards

Note: These documents are applicable under Japanese law, and are added here for reference only to align with the original Japanese version of this document.

1.3 Related Documents

(1) Regulations concerning repeater stations and remote-controlled stations established by the (Japan) Radio League
(2) Frequency and radio equipment conditions for repeater stations
(3) Radio type, frequency, and radio equipment of remote-controlled stations
(4) Japanese Patent No. 4493467*
(5) Japanese Patent No. 4919594*
(6) Patent Publication Approval Document
(7) D-PRS Authorization

* Note: The patents indicated above are registered only in Japan. Contact with Icom is required if an entity wishes to produce and or sell a D-STAR compatible product, device, application or service within the Japanese market.

Chapter 2 Overview

2.1 Structure of the standard system

The D-STAR system is a system that can connect to the Internet through "repeater stations", "assist stations", and "gateways (GW)", and can communicate with radio stations in remote areas via data and voice. The overall configuration is shown in "2.1.1 System Configuration."

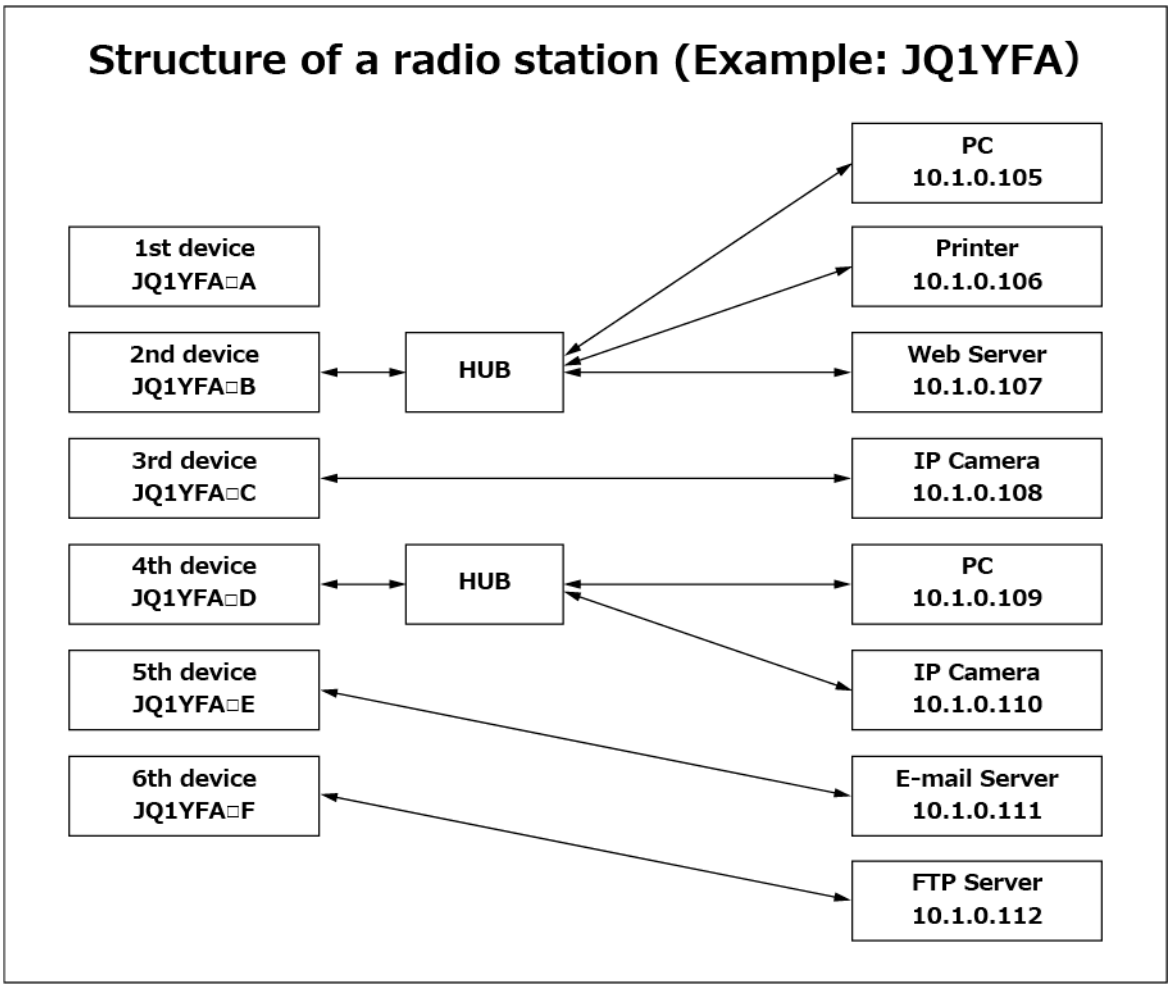
In communication using repeater stations, an "assist station" that multiplexes data and voice communication using the microwave band, which provides wide bandwidth, is used to connect repeater stations, and a maximum of four repeater stations can be connected. A "zone" is defined as a service area where multiple repeater stations are connected by assist stations. In addition, inter-zone communication can be performed using the Internet via the GW to communicate with terminal stations in different zones. A repeater station connected to the Internet within a zone is called a "zone repeater station".

A radio terminal station is configured as shown in the figure on the right, and up to six radio terminals from A to F can be assigned to one call sign, and they are identified by adding the last character (eighth character), such as J$1QQQ_A. This character is hereinafter called the identification code. In the case of a two-character call such as J$1RL, it is specified as J$1RL_ _A. However, in the case of a single radio terminal station, the identification code can be omitted.

In addition, multiple IP addresses may be assigned to a single call sign, and the addresses may be assigned to PCs and other IP devices connected to the Radio terminal.

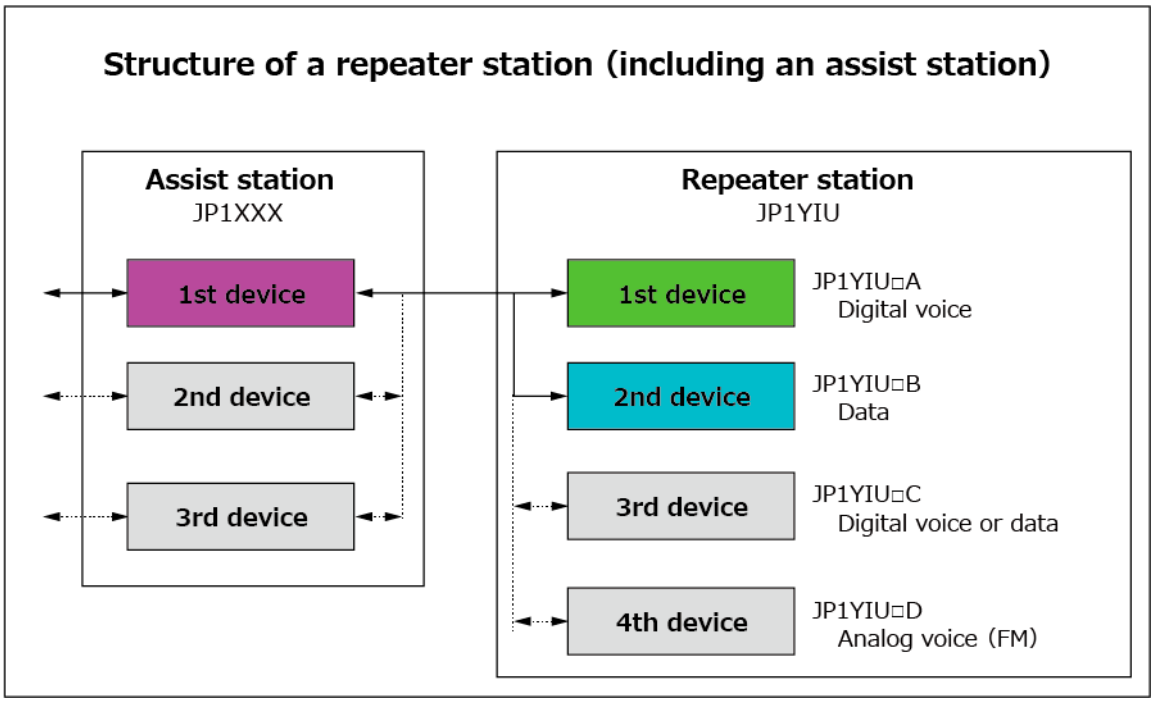
Example: Radio terminal A = Voice communication

Radio terminals B to F = Data communication (connecting IP devices such as PCs, printers, cameras, etc.)

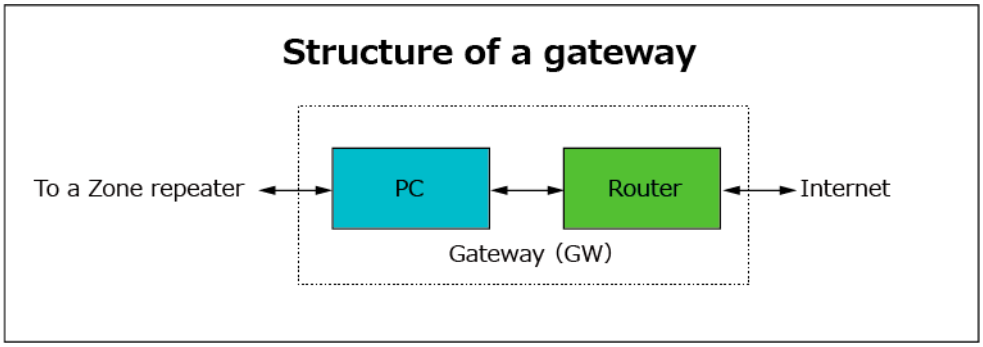


As shown in the figure below, up to four repeater stations (four frequencies) connected to the assist station can be installed in the same frequency band (of which one frequency band can be changed to an analog repeater device), and like the radio terminal, they are identified by adding the codes A to D at the end of the call sign. A zone is configured by trunk line type communication with up to four repeater stations connected as described above.

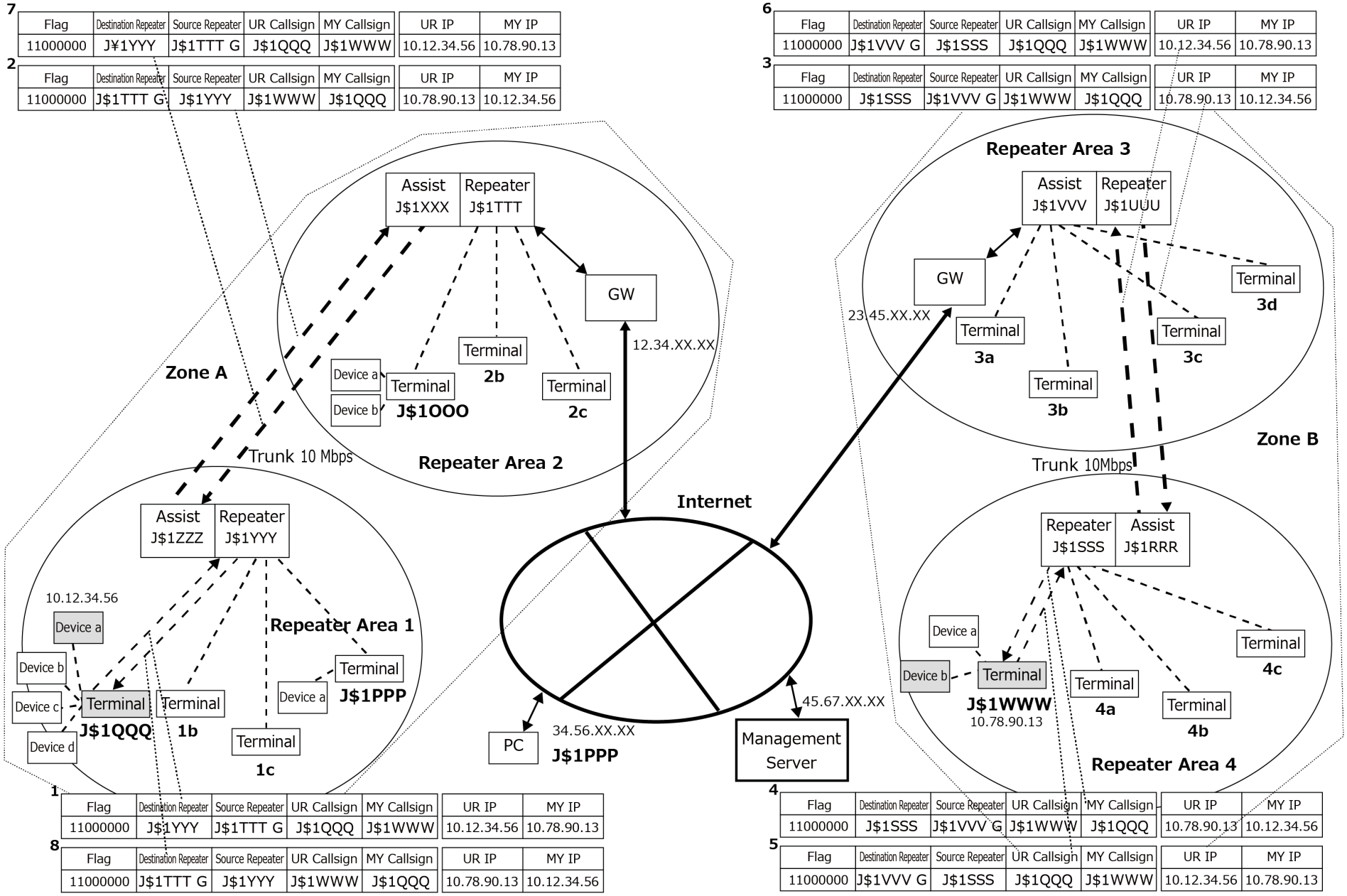
In the case of a repeater station that is not connected to an assist station, the maximum number of frequencies allowed is three (one of which is an analog repeater). (Screening criteria related to the Radio Act)



A GW (gateway) connected to a “Zone Repeater station” is structured as shown.



2.1.1 System Structure



2.2 Repeater stations

In the same way as a conventional analog FM repeater system, it is possible to communicate with the repeater station by return back. In this case, the call sign of the repeater station is set as follows in the example of Repeater Area 1.

Destination Repeater	Source Repeater	UR Callsign	MY Callsign
J$1YYY	J$1YYY	J$1PPP	J$1QQQ

2.3 Intra-zone communication

Communication is possible within a zone in which multiple repeater stations are connected by assist stations. In the case of communication through Repeater Area 1 and Repeater Area 2, the call sign is set as follows.

a. In the case of a call from a repeater station in the repeater area to which the other station belongs, the call sign of the repeater station is specified as the destination relay call sign and transmitted.

Destination Repeater	Source Repeater	UR Callsign	MY Callsign
J$1TTT	J$1YYY	J$1OOO	J$1QQQ

b. The destination repeater station transmits a downlink signal to the destination station using the signal sent from the assist station.

(1) Voice communication

a. The other party terminal station in each repeater area can be specified for communication.

b. In the case of an unspecified call (CQ call), a repeater station to which the terminal station belongs can be specified and called.

Destination Repeater	Source Repeater	UR Callsign	MY Callsign
J$1TTT	J$1YYY	CQCQCQ	J$1QQQ

c. In the case of voice communication via an assist station, the radio wave is transmitted only at the specified destination repeater station. However, the down-link of the repeater station to which the calling station belongs, shall be transmitted as it is.

(2) Data communication

a. The other party terminal station that belongs to each repeater area is specified and communication is carried out.

b. The data communication is performed by the TCP/IP protocol, and the immediacy is not guaranteed.

c. In the case of the transmission of the data from a terminal station to a repeater station, the data is transmitted alternately in time using the packet method (half-duplex communication) and transmission and receive is done on the same frequency (simplex).

2.4 Inter-zone communication

Inter-zone communication is possible between different zones via the Internet. The signal from the zone repeater connected to the GW contacts the "Administration Server" with the call sign of the other station, and is connected to the other GW with the information of the other party's zone, repeater, GW, etc. returned from the "Administration Server". The other party GW sends a signal to the repeater station to communicate with the other party.

(1) Communication with another station

a. Specify the GW to be connected to the GW in the destination relay callsign and send it.

Destination Repeater	Source Repeater	UR Callsign	MY Callsign
J$1TTT□G	J$1YYY	J$1WWW	J$1QQQ

b. The GW makes an inquiry to the "Trust Server" and receives its reply.

c. The GW uses the information to send a signal to the other party's GW via the internet.

d. The other party's GW sends a signal to the repeater station to which the other party's GW belongs.

e. The handling of data and voice is the same as that of intra-zone communication

(2) Repeater area CQ

The caller can send an unspecified CQ call in the desired repeater area. In the case of a call to the other station, a "/" is added to the beginning of the call sign to specify the desired repeater call sign.

In the case that the target repeater station has multiple repeaters, an unspecified CQ call can be made from the repeater by adding an identification code. When there are multiple repeater stations and the identification code is not added, A is specified as the standard value.

Destination Repeater	Source Repeater	UR Callsign	MY Callsign
J$1TTT□G	J$1YYY	/J$1SSSA	J$1QQQ

(3) Movement of a terminal station

It is possible to operate a terminal station even if it moves to a place different from the repeater area or zone to which it belongs.

a. If the repeater call sign and frequency of the area match the setting of the terminal, the terminal station can call another station as it is. In the case of a station that is not in a repeater area, it is possible for the station to send a call to the other station or send a CQ (without sending a signal for registration).
b. The repeater station in the repeater area rewrites its table and passes the information to the GW.
c. The GW asks the "Trust Server" to rewrite the table. The GW asks the "Trust Server" to rewrite the table.
d. The "Trust Server" rewrites the table by replacing the old and new tables.

2.5 Access to the Internet

The station can connect to the Internet. In the same way as inter-zone communication, communication is performed through the GW of the zone to which the station belongs.

a. The call sign of the other station sets the zone repeater. In this case, the call sign of the other station sets the zone repeater, and the destination relay call sign specifies the G for connecting to the GW and sends it.

Destination Repeater	Source Repeater	UR Callsign	MY Callsign
J$1TTT□G	J$1YYY	J$1TTT	J$1QQQ

b. The GW connects to the Internet.

c. Set the IP address of the PC connected to the terminal station, etc., and access the Internet.

2.6 Communication without using a repeater station

a. For voice and data communication without using a repeater station, the call sign of the other station is set and communication is performed. In this case, the call sign is "DIRECT" for the destination and source relay call signs.

Destination Repeater	Source Repeater	UR Callsign	MY Callsign
DIRECT	DIRECT	J$1NNN	J$1QQQ

2.7 Communication by Analog FM

An existing voice FM radio can be used to communicate with a D-STAR system by adding an adapter that manages the call sign information of the other party and the repeater station. Analog FM repeater equipment can be used by adding an interface between the conventional FM repeater and the D-STAR system.

2.8 Communication via the Internet

The D-STAR system is a comprehensive communication system that combines the wireless and Internet sections, and the Internet section uses a VPN (Virtual Private Network) for transmission. In order to use the Internet for inter-zone communication as described in 1.4, it is necessary to register the information of the radio stations to be used in the "Trust Server".
As shown in the system configuration diagram in Section 2.1.1, a radio station in Repeater Area 1 can communicate with a radio station in Repeater Area 4. As shown in the system configuration diagram in Section 2.1.1, in the case of inter-zone communication, when the signal arrives at the GW in Repeater Area 2, the GW sends an inquiry to the "Trust Server" and obtains the information of the other station, so Repeater Area 2 knows that it can communicate with the other station through the GW in Repeater Area 3. After that, GWs in Repeater Area 2 and 3 communicate with each other to enable communication with the other station.

2.9 IP address to be used

For the time being, the IPv4 IP address is used. In addition, consideration shall be given so that IPv6, which is expected to spread rapidly in the future, can also be introduced.

2.10 Packet Monitoring

The D-STAR data communication is based on the TCP/IP protocol with a radio part header added. It shall be possible to intercept this communication even if it is not addressed to the own station.

Chapter 3 Technical Requirements for Radio Systems

3.1 Voice-based communication equipment

3.1.1 General Conditions

(1) Communication method:

The system shall transmit digital signals in a half-duplex mode.

(2) Contents of communication:

The transmission of digitized voice and acoustic signals shall be performed. In addition, it shall be possible to use "voice frames" to transmit voice and acoustic signals and "data frames" to transmit them alternately, and to transmit resynchronization signals to further stabilize the line product and small-capacity data that can be used freely by users.

(3) Frequency band used:

The frequency band to be used shall be the amateur radio frequency band using accepted modulation methods and occupied frequency band widths.
(Article 61 of the Radio Act, Article 258-2 of the Radio Station Operation Regulations, Ministry of Internal Affairs and Communications Notification No. 179 of March 25, 2009, effective March 30, 2009)

(4) Operating environment conditions:

No specific operating environment conditions are specified.

3.1.2 Transmitting equipment

(1) Antenna power

Amateur station: Less than or equal to the licensed antenna power

Repeater station: Conforms to the regulations related to repeater stations

(2) Permissible deviation of antenna power

Radio station equipment rules shall apply (upper limit 20%)

(3) Modulation method:

GMSK, QPSK, 4-level FSK

(4) Transmission speed:

4.8 kbps or less

(5) Audio coding method

AMBE-2020 conversion rate 2.4 kbps, code with FEC 3.6 kbps, or compatible mode of this mode (mode indicated as DSTAR compatible mode in the specification of AMBE)

(6) Spurious emission strength:

Radio station equipment rules apply.

(7) Occupied frequency bandwidth: 6 kHz or less

3.1.3 Receiving equipment

The receiver shall have a performance that satisfies the provisions of Chapter 3, Article 24 and Article 25 of the Radio Equipment Regulations.

3.1.4 Transmission and reception characteristics

Amateur stations: Manual or automatic switching. Transmit/receive switching time: 100 ms or less.

Repeater station: Automatic switching. Transmission/reception switching time 100 ms or less

3.1.5 Antenna

Amateur station: Licensed antenna

Repeater station: Complies with the regulations related to repeater stations

3.1.6 Others:

(1) The interval between the transmission and reception frequencies of the repeater equipment shall be in accordance with the relevant provisions of the repeater station.

(2) Repeater equipment that transmits and receives simultaneously shall be equipped with an antenna multiplexer and filter to reduce the effect of sensitivity suppression.

(3) The repeater equipment shall have a communication control function for transmission control and exchange of information in the format specified by the assist station and GW.

(4) For scrambler and error correction, refer to "Ap.2 Error Correction and Interleaving".

3.2 Data communication equipment

3.2.1 General conditions

(1) Communication method

Simplex method shall be used.

(2) Contents of communication

The equipment shall transmit digitized information.

(3) Frequency band used

The frequency band to be used shall be the amateur radio frequency band using accepted modulation methods and occupied frequency band widths.

(Article 61 of the Radio Act, Article 258-2 of the Radio Station Operation Regulations, Ministry of Internal Affairs and Communications Notification No. 179 of March 25, 2009, effective March 30, 2009)

(4) Operating environment conditions

Not specified.

3.2.2 Transmitting equipment

(1) Antenna power

Amateur station: Less than or equal to the licensed antenna power

Repeater station: Complies with the relevant regulations for repeater stations

(2) Permissible deviation of antenna power

Radio station equipment rules shall apply (upper limit 20%)

(3) Modulation method

GMSK, QPSK, 4-level FSK

(4) Transmission speed: 128 kbps or less

(5) Spurious emission strength:

Radio equipment regulations apply.

(6) Occupied frequency band width:

150 kHz or less

3.2.3 Receiving equipment

The receiver shall have a performance that satisfies the provisions of Chapter 3, Article 24 and Article 25 of the Radio Equipment Regulations.

3.2.4 Transmission and reception characteristics

Automatic switching. The transmission/reception switching time shall be 50 ms or less.

3.2.5 Antenna

Amateur stations: Licensed antennas

Repeater stations: Comply with regulations related to repeater stations

3.2.6 Others

For scrambler and error correction, refer to "Ap.2 Error Correction and Interleaving".

3.3 Assist station communication equipment

3.3.1 General conditions

(1) Communication method

The full-duplex method shall be used.

(2) Contents of communication:

The communication transmission between repeater stations shall be performed by multiplexing digitized voice, sound and data.

(3) Frequency band used:

10 GHz band and 5.6 GHz band amateur radio frequency band (Radio Related Examination Standards)

(4) Environmental conditions for use:

There are no specific requirements, however, since the equipment is expected to be installed in close proximity to the antenna, it shall have an environmental performance that fully satisfies the environmental conditions in which it is installed.

3.3.2 Transmitter equipment

(1) Antenna power

2 W or less

(2) Permissible deviation of antenna power:

Radio station equipment regulations shall apply (upper limit 20%)

(3) Modulation method:

GMSK

(4) Transmission speed:

10 Mbps or less

(5) Intensity of spurious emissions:

The Radio Equipment Regulations shall apply.

(6) Occupied frequency band width:

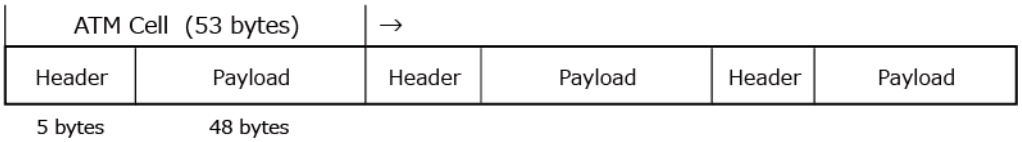
10.5 MHz or less

3.3.3 Receiving equipment

The receiver shall have a performance that satisfies the provisions of Chapter 3, Article 24 and Article 25 of the Radio Equipment Regulations.

3.3.4 Multiplexing method

The multiplexing method for assist station communication shall be the ATM method, and the details shall conform to the ATM specifications. However, priority shall be given to voice transmission.



3.3.5 Antenna

The transmission antenna of the assist station shall meet the requirements of the Radio Act related examination standards.

3.3.6 Others

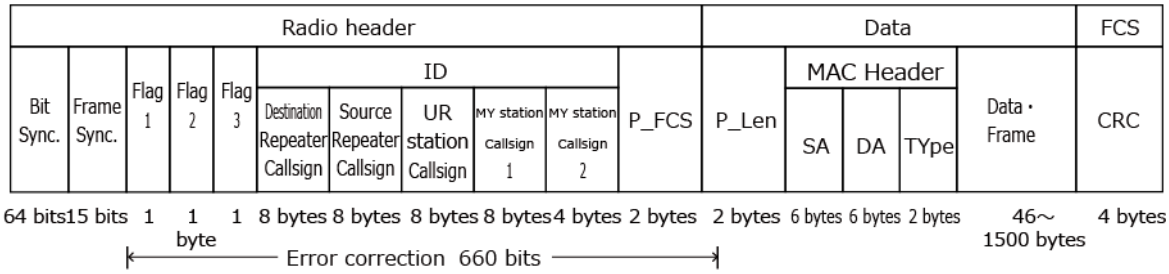
For scrambler, error correction and interleaving, refer to "Ap.2 Error Correction and Interleaving".

Chapter 4 System Requirements for Interconnection

4.1 Radio Communication Packet

The frame structure of a radio communication packet shall be as follows.

4.1.1 Frame structure of the data packet.



The explanation of each part of the data packet frame is as follows.

a. "Bit synchronization" shall be "1010" in case of GMSK modulation, and "1001" in case of QPSK modulation, repeating 64 bits as the standard. The transmission direction shall be from the highest level on the left to the lowest level on the right.

b. "Frame synchronization" shall be 15 bits (111011001010000). The transmission direction shall be from the left-most level to the right-most level.

c. "Flag 1" (8 bits)

The flag 1 uses the upper 5 bits and the lower 3 bits of the 8 bits, and the specific explanation is as follows.

Bit7(MSB)	Identify data and voice communications.
Bit6	It identifies whether it is a signal through a repeater site or a direct communication between terminals. (The value is 1 for a signal to the repeater and 0 for a signal to the terminal.)
Bit5	Identifies the presence or absence of interrupt (break-in) communication
Bit4	Identification of control signal/data signal. 1 means a control signal, 0 means a normal data signal (including a voice signal).
Bit3	When the flag is set to 1, it means emergency communication, and when it is set to 0, it means a normal signal. When a signal with this flag is received, the receiving device is forced to open the squelch or otherwise make itself available for receiving information. Note: Emergency communications in this chapter do not refer to "emergency communications" under the Japanese Radio Act, but to communications that require urgent communication such as natural disasters, accidents, and rescue of human lives.
Bit2 to 0	111 = Flag at the time of the control of the repeater station After setting this flag, various controls are performed by sending special commands for control. 110 = Automatic response 101 = Not used (spare) 100 = Retransmission request flag This flag has the meaning of a retransmission request. 011 = ACK flag A reply is returned as an ACK flag. 010 = This flag is used when there is no response. 001 = Unrelayable flag This flag is added to the message when it cannot be relayed because it does not meet the relay conditions. 000 = NULL Indicates that the message does not correspond to any of the above conditions.

	Upper bit				
Bit	7	6	5	4	3
1	Data	Relay	Interruption	Control	Emergency communication
0	Voice	Direct	No interruption	Data	Normal communication

Lower bit				
2	1	0	Function	Note
1	1	1	Repeater Control	Repeater Control Mode
1	1	0	Automatic response	Used when Automatic response
1	0	1	Not used	Not used
1	0	0	Resending	Retransmission request flag
0	1	1	ACK	ACK flag
0	1	0	No Response	Indicates No Response Flag
0	0	1	Unrelayable	Indicates Unrelayable Flag
0	0	0	NULL	NULL

d. "Flag 2".

Flag 2" is defined as follows for future extensibility.

Bit	7	6	5	4	3	2	1	0	Remarks
Flag	ID				M				
	(0000h)				(****h)				Default

The "ID flag" is used to identify the ID format.

The "M" is used for checking the manufacturer's specific information, and is not managed in the system.

e. "Flag 3".

Flag 3 is the space reserved for future use, and is mainly used to make the system behave as needed for the version.

f. The "Destination Repeater Station Call Sign" shall be a maximum of 8 ASCII characters and the remaining spaces shall be filled with spaces. (See 4.2.1 (1))

For direct communication, enter "DIRECT" and fill in the remaining spaces with spaces.

g. "Source Repeater Station Call Sign" shall be up to 8 characters in ASCII code, and the remaining spaces shall be filled with spaces. (See 4.2.1(2).) In case of direct communication, "DIRECT" shall be inserted and fill in the remaining spaces with spaces.

h. The maximum size of the "Other Call Sign" is 8 ASCII characters and the remaining spaces are filled with spaces (See 4.2.1(3). In inter-zone communication, the GW reconstructs the ID part with the callsign obtained from the "Trust Server". In this case, the "originating relay call sign" is the "peer zone repeater station", and "G" is added to the end of the call sign.

i. Own station callsign 1: The "own station call sign 1" shall be a maximum of 8 ASCII characters and the remaining spaces shall be filled with spaces. (See 4.2.1(4).
It is applicable to other than data communication. For example, "JA1RL_ _F".

j. Own station callsign 2: In the case of a call from a station that has been assigned a specific call sign, the call sign shall be set to a maximum of four ASCII characters and the remaining spaces shall be filled with spaces.

k. "P_FCS" is an error check of the radio part header. The generation polynomial is generated by the following equation according to CRC-CCITT.

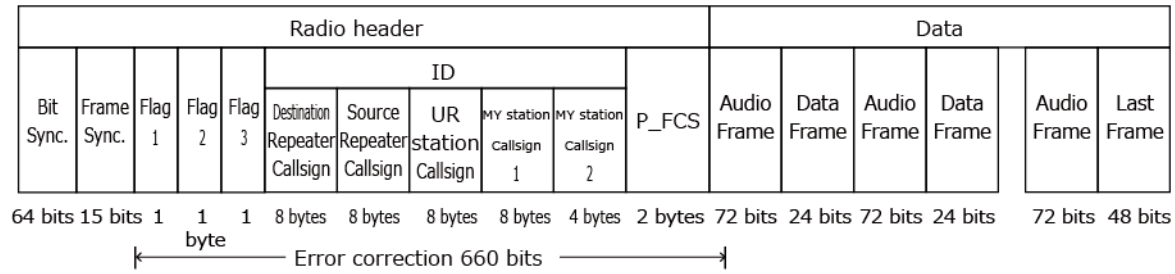
$$G(x) = x^{16} + x^{12} + x^5 + 1$$

l. The "data part" uses TCP/IP packets.

m. The "FCS" performs error checking of the data part only. The generated polynomial is the CRC-32 algorithm of ISO 3309 standard. The generated polynomial is generated by the following equation using the ISO 3309 standard CRC-32 algorithm.

$$G(x) = x^{32}+ x^{26}+ x^{23}+ x^{22}+ x^{16}+ x^{12}+ x^{11}+ x^{10}+ x^8+ x^7+ x^5+ x^4+ x^2+ x+ 1$$

4.1.2 Frame Structure of the Voice Packet



The explanation of each part of the voice packet frame is as follows.

a. The "radio part header" has the same structure as the data packet frame.

b. The "data part" consists of a 72-bit voice signal with a repetition period of 20 ms in accordance with the AMBE-2020 (with FEC) standard or compatible mode.
The "data frame" consists of 24 bits of data other than voice. In the "data frame", 24 bits of data other than voice shall be sent.

c. A resynchronization signal corresponding to the modulation method shall be inserted at each of the first 21 "data frames" and "voice frames". By re-synchronizing in this section, it is possible to reduce the synchronization clock gap between transmission and reception, including reception from the middle of communication.

d. To distinguish the resynchronization signal from the audio, 10-bit bit synchronous signal and Third M-sequence code 7-bit "1101000” are sent twice (Total 24 bit). The direction of transmission is from the highest level on the left to the lowest level on the right-lowermost.
[In case of resynchronization signal (GMSK)].
The 10-bit synchronization signal has the same structure as the first bit synchronization signal of the voice packet. In the case of GMSK, it is 1010101010, and the overall notation is as follows.
“101010101011010001101000”

e. The "data frame", which can be used freely by the user, shall be here where the input signal is sent as it is. Necessary data processing such as error correction and synchronization signals shall be handled on the input signal side. Therefore, in the transmission direction, the input signals shall be sent sequentially.

f. If the data signal is longer than the voice signal, it should be processed manually by holding down the standby switch until the end of the signal. The addition of a similar function from outside is not prohibited.

g. The last "data frame" shall be the last frame of the transmission, and the unique pattern shall be placed on it as the end of the voice signal.

h. The pattern of the last frame shall be the repetition of the synchronization signal corresponding to the modulation method, 32 bits + 15 bits “000100110101111” + 0. The transmission direction shall be from the highest level on the left to the lowest level on the right, and the last frame shall be "0".

4.1.3 Data frame

The data frame shall be used in accordance with the definition in Chapter 6 "Data Frame", except for the resynchronization signal inserted into the data frame every 21 voice frames.

4.1.4. Fast Data

When the PTT is pressed, a transition shall be made so that the voice is transmitted as a normal voice frame immediately. For the switching procedure, refer to "Chapter 7 Fast Data".

4.2 Communication protocol

4.2.1 Call sign

The call sign in the radio header of data and voice packets is used for routing to determine the communication path. The call sign of the radio part header of the data and voice packets is basically used for routing to determine the communication route, and other than the own station call sign, the basic alphanumeric characters shall be 6 (or 7) or less.

(1) "Destination Repeater Call Sign

- In the case of a communication within a zone, the repeater call sign of the repeater area to which the other station belongs is specified.
- When there are multiple repeaters in a repeater site, "A to D" can be added to the eighth character to specify the repeater call sign. (Example: JA1YRL_A, JA1YRL_D, etc.) When there are multiple repeaters and the eighth character is not specified, "A" is specified as the standard value.
- In the case of inter-zone communication with a partner station outside the zone, specify the zone repeater call sign that connects to the GW connected to the Internet, and add "G" to the eighth character. (Example: JA1YRL_G)

(2) "Source Repeater Call Sign

"Source Repeater Call Sign" - Specifies the repeater call sign of the repeater area to which the station belongs. When there are multiple repeater devices in the repeater site, the eighth character can be specified with "A to D".(Example: JA1YRL_A, JA1YRL_D, etc.) If there are multiple repeater devices and the eighth character is not specified, "A" is specified as the standard value.

(3) "Other station call sign

- In the case of multiple repeater devices, "A" to "F" can be added to the eighth character. (e.g., J$1AAA, J$1AAA□F, etc.)
- In the case of an unspecified call, "CQCQCQ" shall be specified for communication.
- In the inter-zone communication, when an unspecified call is made from a specified repeater station, the repeater call sign is specified by prefixing "/" to the "other station call sign". When there are multiple repeater devices at the repeater site, "A to D" can be added to the eighth character to specify the repeater call sign. (Example. (e.g., /JA1YRL_A, /JA1YRL_D, etc.) If there are multiple repeater devices and the eighth character is not specified, "A" is specified as the standard value diff.
- When a call is made to a repeater station that has a local server, the repeater call sign shall be specified in the "Other station call sign" field, and "S" shall be added to the eighth character.

(4) “Own station call sign 1”

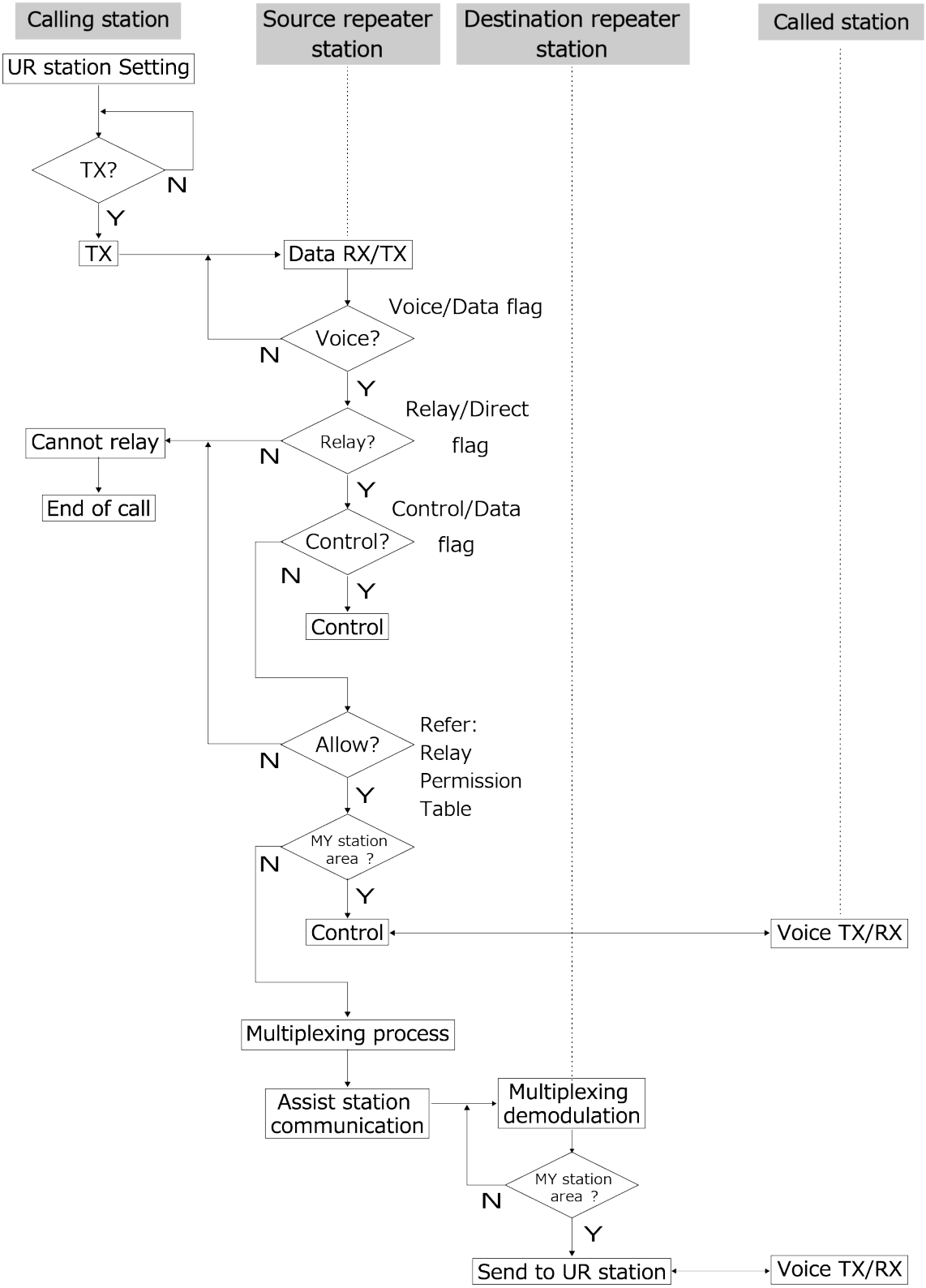
In the case of a multiple device, "A" to "F" can be added to the eighth character. (e.g., J$1AAA_A, J$1AAA_F, etc.)

(5) "Own station call sign 2”

When a call sign is assigned to a mobile station or a specific call sign is assigned, the call sign is usually indicated with a diagonal line.

4.2.2 Voice communication in the same zone

(1) Voice communication flow in the same zone



(2) Procedures for voice communication flow in the same zone

1. Reception of terminal signals

2. Judgment process

a. Flag check

(1) Data/voice flag

The flag indicating voice communication is "0"?

Ignore flags other than "0".

(2) Relay / Direct flag

The flag indicating relay communication "1"?

“0” = replies with a flag indicating that relaying is not available.

(3) Control/data flag

The flag indicating data "0"?

“1” = Control processing is performed.

b. Refer to the relay permission table

This function refers to the own station (sending station) and the relay permission table in the radio part header of the received packet.

If relay is possible, relay processing is performed. If the conditions are such that relaying is not possible, the message is returned with a "cannot relay" flag attached.

c. Determination of the repeater area

When the other station is in the repeater area, it shall send a reply with the "cannot relay" flag. This message is sent from the base station.

(3) Control processing

a. Emergency Repeater Stop

This operation is performed when the function of the repeater must be stopped urgently.

b. Emergency cable connection stop

When the connection to the Internet must be stopped urgently, this operation is performed.

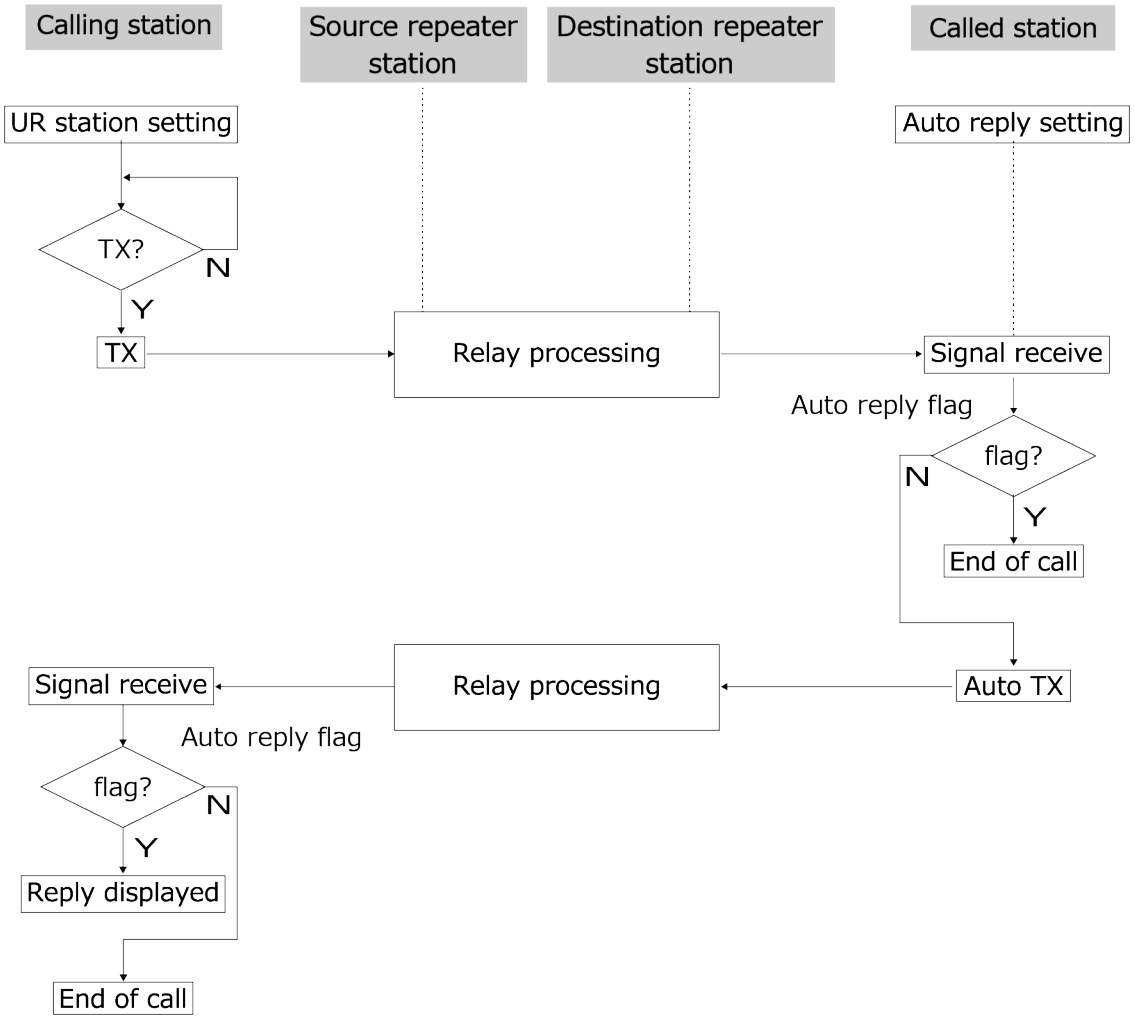
(4) Multiplexing process

It is judged by the call sign of the destination repeater station and the source repeater station in the radio section header. If the two stations are not in the same repeater area, the multiplexing process is performed.

(5) Transmission to the other station

When the transmission is in the same repeater area, the necessary data is prepared and transmitted to the other station.

(3) Automatic response within the same zone



The following procedure is used for automatic response.

Description of automatic response procedures within the same zone

Automatic response performs the following operations for each of the communication methods already described.

a. The terminal that intends to perform automatic response is set to automatic response mode.

b. The calling station cannot know in advance whether the other station is in the automatic response mode or not.

c. If the other station is in the automatic response mode, it performs the automatic response by taking the timing to be able to respond manually when it is called.

d. At this time, the automatic response flag is set to respond.

e. Even if the automatic response is set, the other station responds to those without an automatic response flag and does not respond to those with an automatic response flag. This prevents an infinite loop.

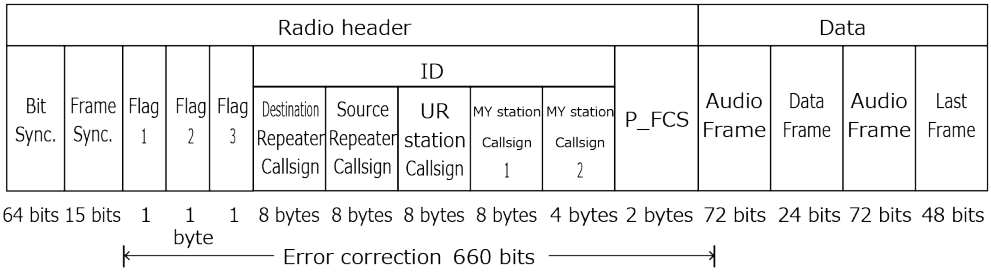
f. The called station knows that the other station is receiving when it receives an automatic response.

g. When the called station responds immediately to the manual response, the automatic response mode is canceled.

h. After confirming the automatic response at the other station, if the other station responds manually, the automatic response mode is canceled.

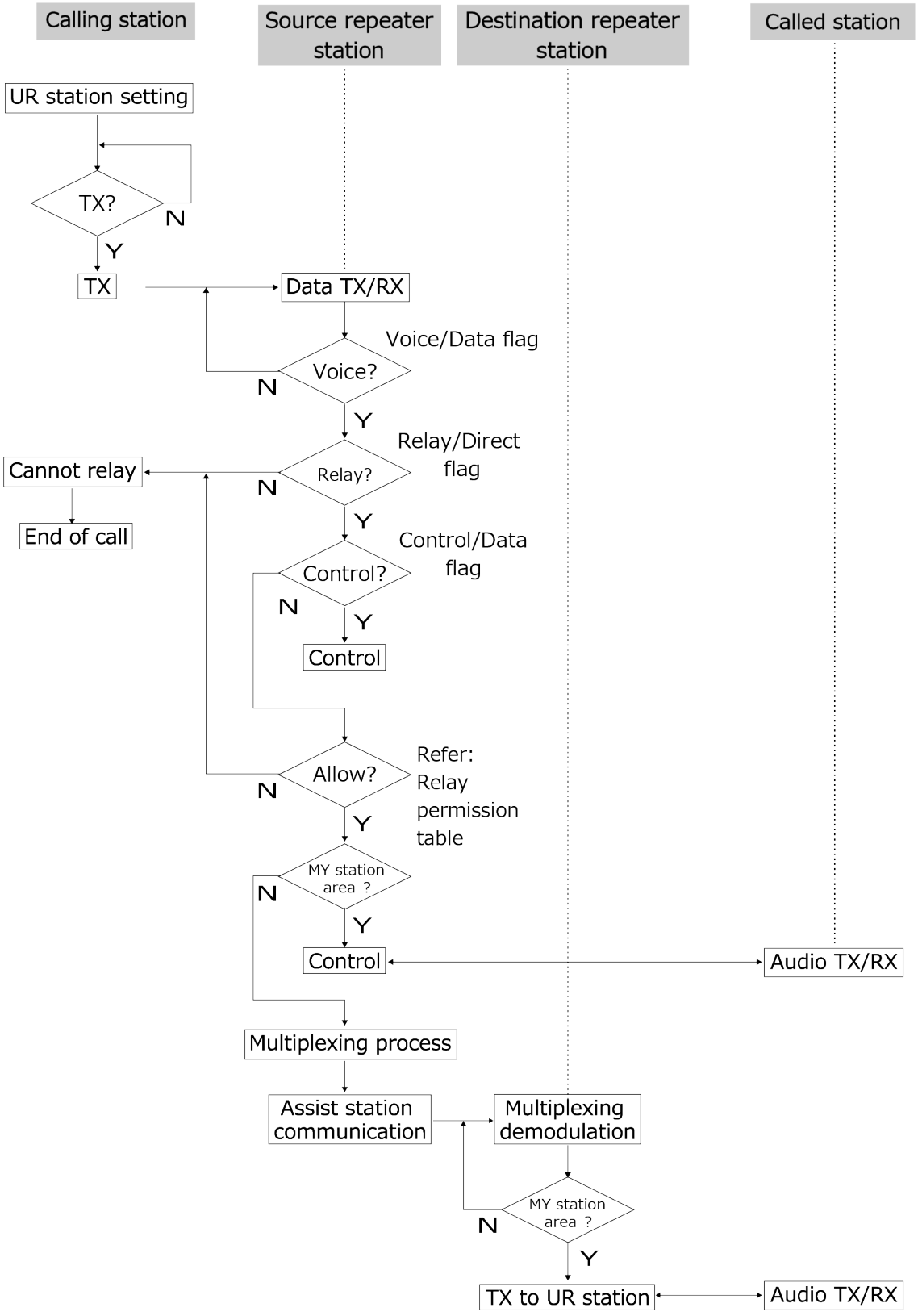
i. An automatic response packet has the same structure as a normal communication except for the flag setting. The length of the packet is the shortest if no message is set in the data frame, but if a message is set, it depends on the length of the message. In this case, the voice frame shall be silence data.

In AMBE codec 3.6 kbps code with FEC (conversion rate 2.4 kbps) or compatible mode, voice frames are filled with silence data and data frames are filled with 66HEX which has no meaning.



4.2.3 Data-based communication within the same zone (intra-zone communication)

(1) Data communication flow within the same zone



(2) Procedures for data-based communication within the same zone

1. Receipt of terminal signal

2. Decision processing

a. Flag checks

(1) Data/Voice Flag

Flag "1" indicating data communication?

Ignore all but "1".

(2) Relay/Direct flag

Flag indicating relay communication "1"?

0" = Return to the terminal with a non-relayable flag added.

(3) Control/Data Flag

Flag indicating data "0"?

1" = control processing.

b. Relay permission table reference

The "Relay Permission Table" is used to identify the station (transmitting station) in the radio section header of the received packet and the station that is allowed to relay the packet.

If it is possible, relay processing is performed. If it is not possible to relay, a non-relay flag is added and the message is returned.

c. Determination of repeater area

Check whether the other station is in the concerned repeater area or not.

(3) Control processing

a. Emergency repeater shutdown

This operation is performed when the repeater device must be stopped urgently.

b. Emergency Wired Connection Shutdown

Perform this action when the connection to the Internet must be stopped urgently.

(4) Multiplexing process

The destination repeater station and source repeater station call signs in the radio section header are used to determine the destination station.

If they are not in the same repeater area, multiplexing is performed.

(5) Transmission to the other station

If they are in the same repeater area, necessary data is prepared and sent to the other station.

4.2.4 Communication between assist stations

(1) Communication conditions The communication conditions shall be as follows

When the receiving signal of the opposing assist station is interrupted, the transmission shall be stopped within 5 seconds.

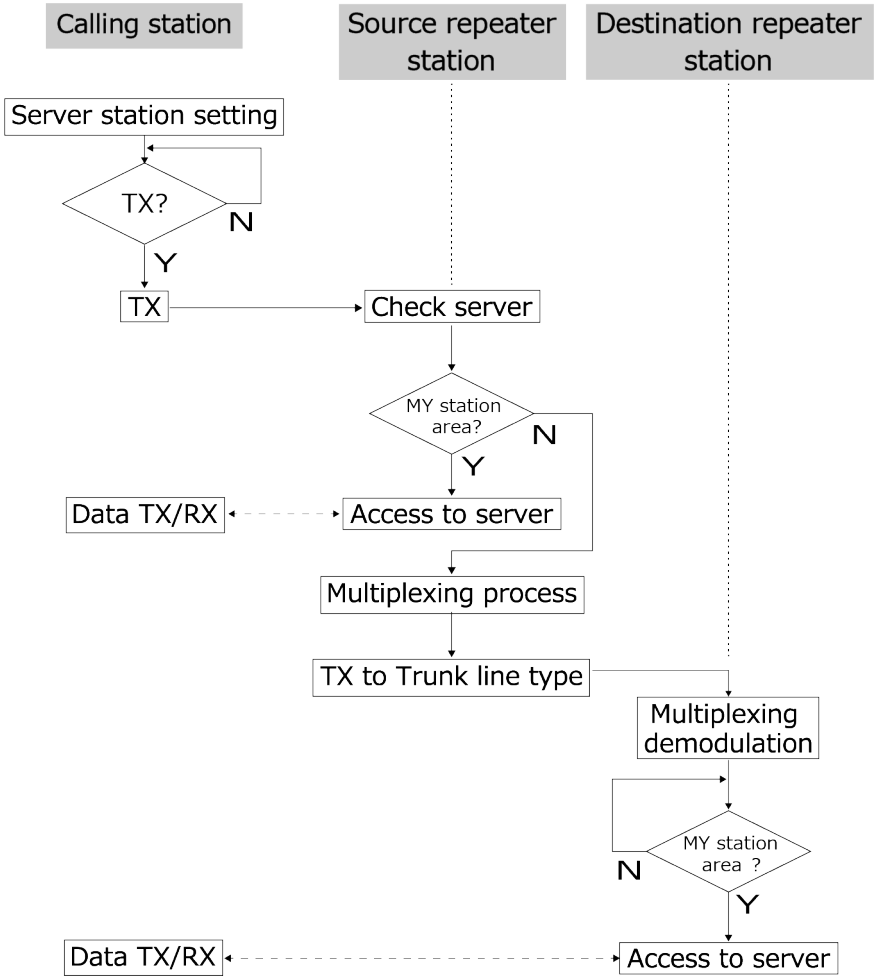
(2) Multiplexing process

The multiplexing process is as follows.

a. The voice signals are made into ATM packets with priority.
b. Turn the data signals into ATM packets.
c. Insert these packets into the trunk stream and send them.
d. Restore the received voice packets according to their priority and send them out for voice communication.
e. The received data packets are restored and sent to the data system.

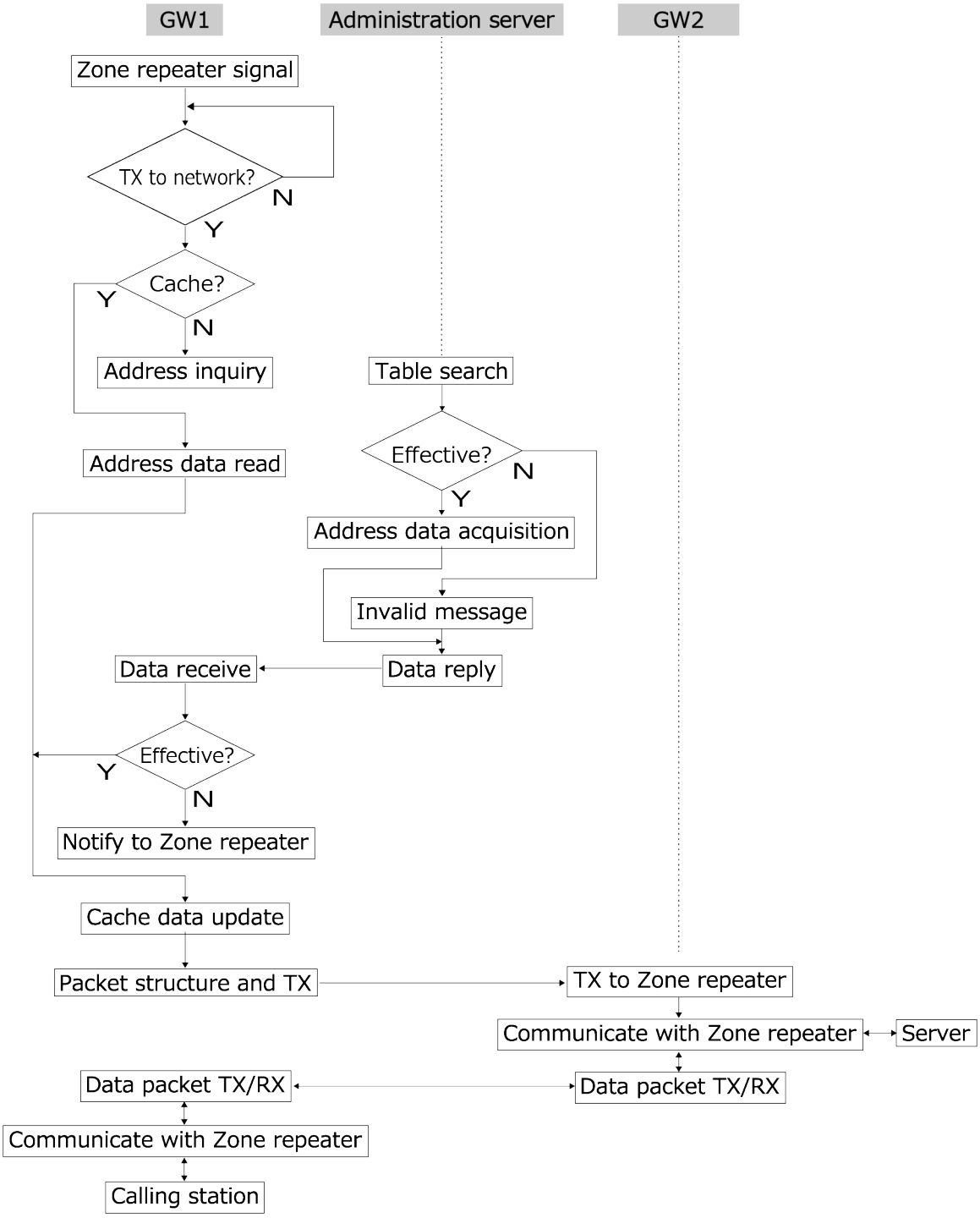
4.2.5 Access to other information terminal equipment

(1) Access to information terminal equipment in the same zone shall be performed as follows.



(2) Access to information terminal equipment outside your zone

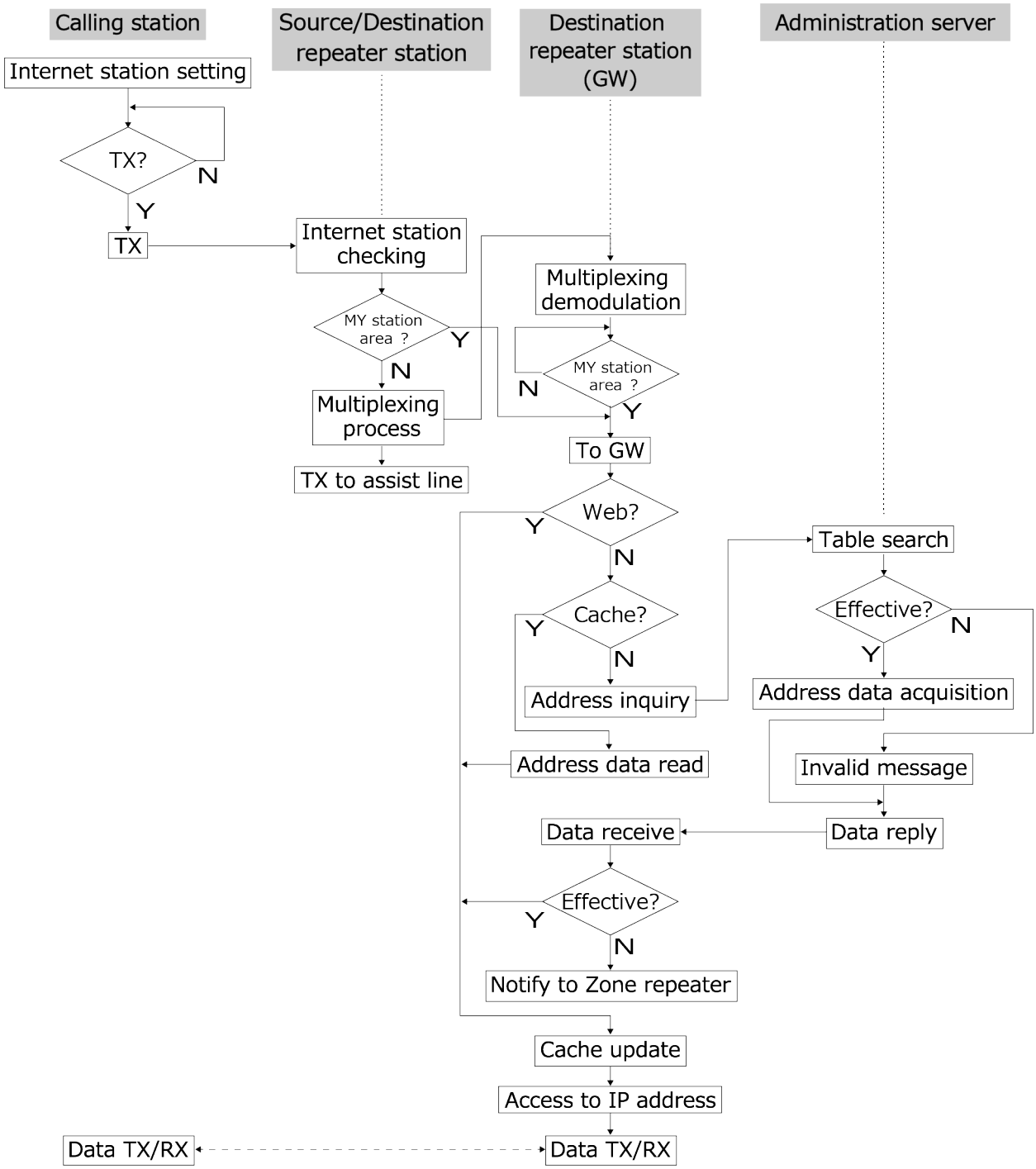
Access to terminal equipment located outside of the zone to which it belongs via the Internet is performed as follows



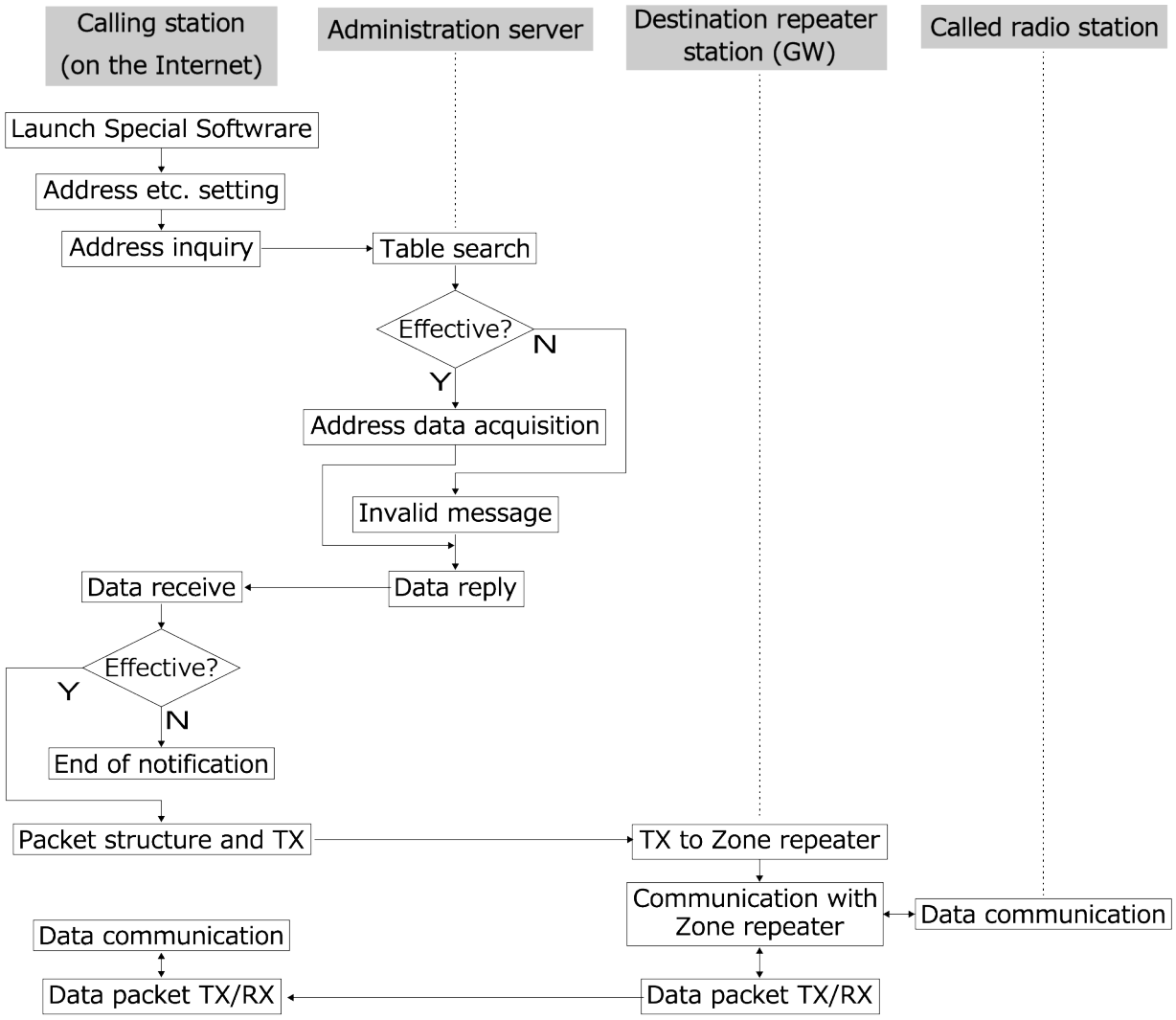
Note: This form of GW communication flow is specific to Japan. It is published here to maintain alignment with the original Japanese document.

4.2.6 Data transmission via the Internet

(1) Access to the Internet or data communication to a station Access to the Internet or communication with a registered station is done as follows.

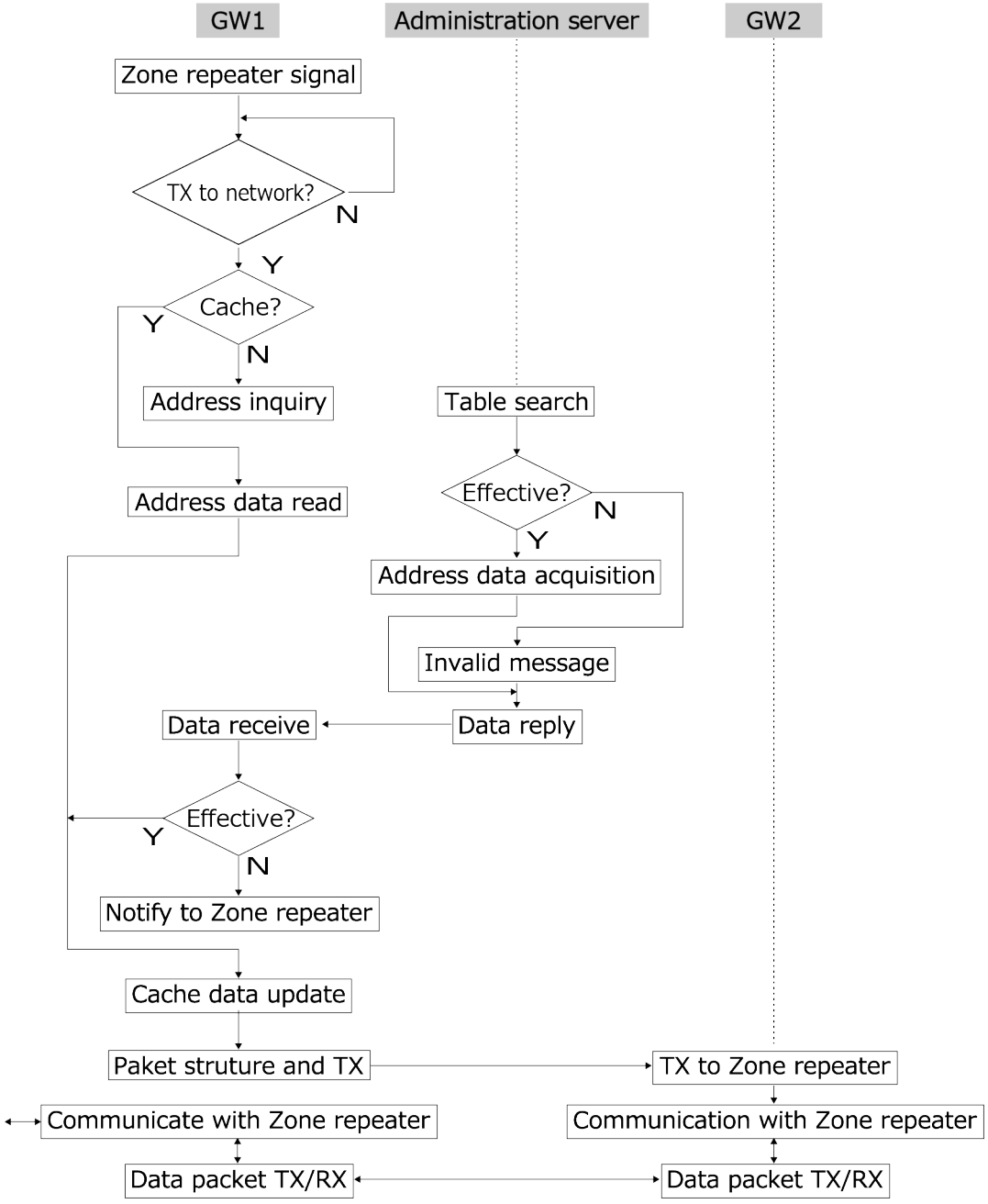


(2) Data communication to call a radio station from the Internet. When calling a terminal radio station in each repeater area from a station on the Internet, the following procedure is used.



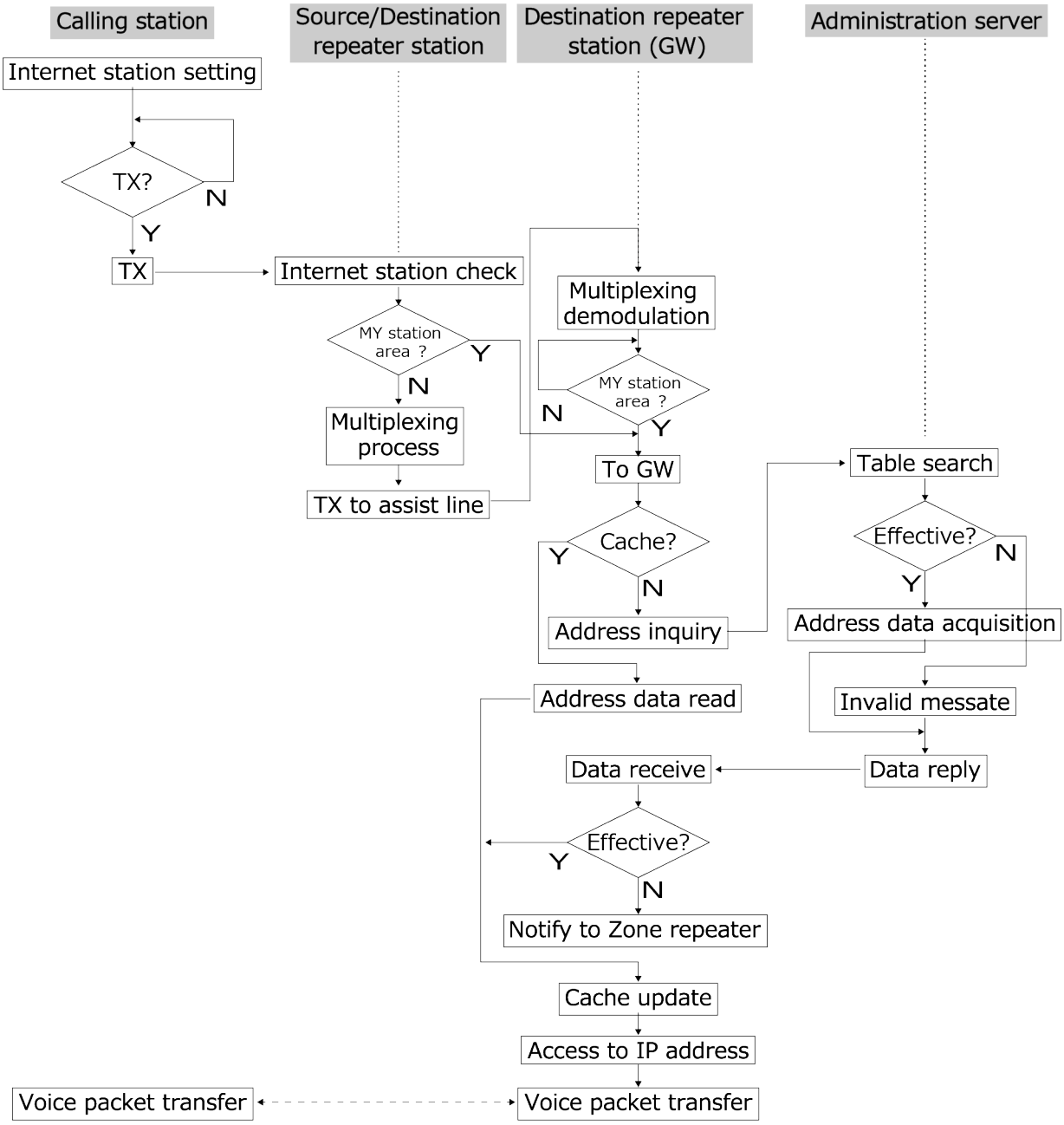
(3) Data communication with radio stations other than the zone to which the user belongs (inter-zone communication)

Communication with radio stations other than the zone to which the user belongs via the Internet is performed as follows

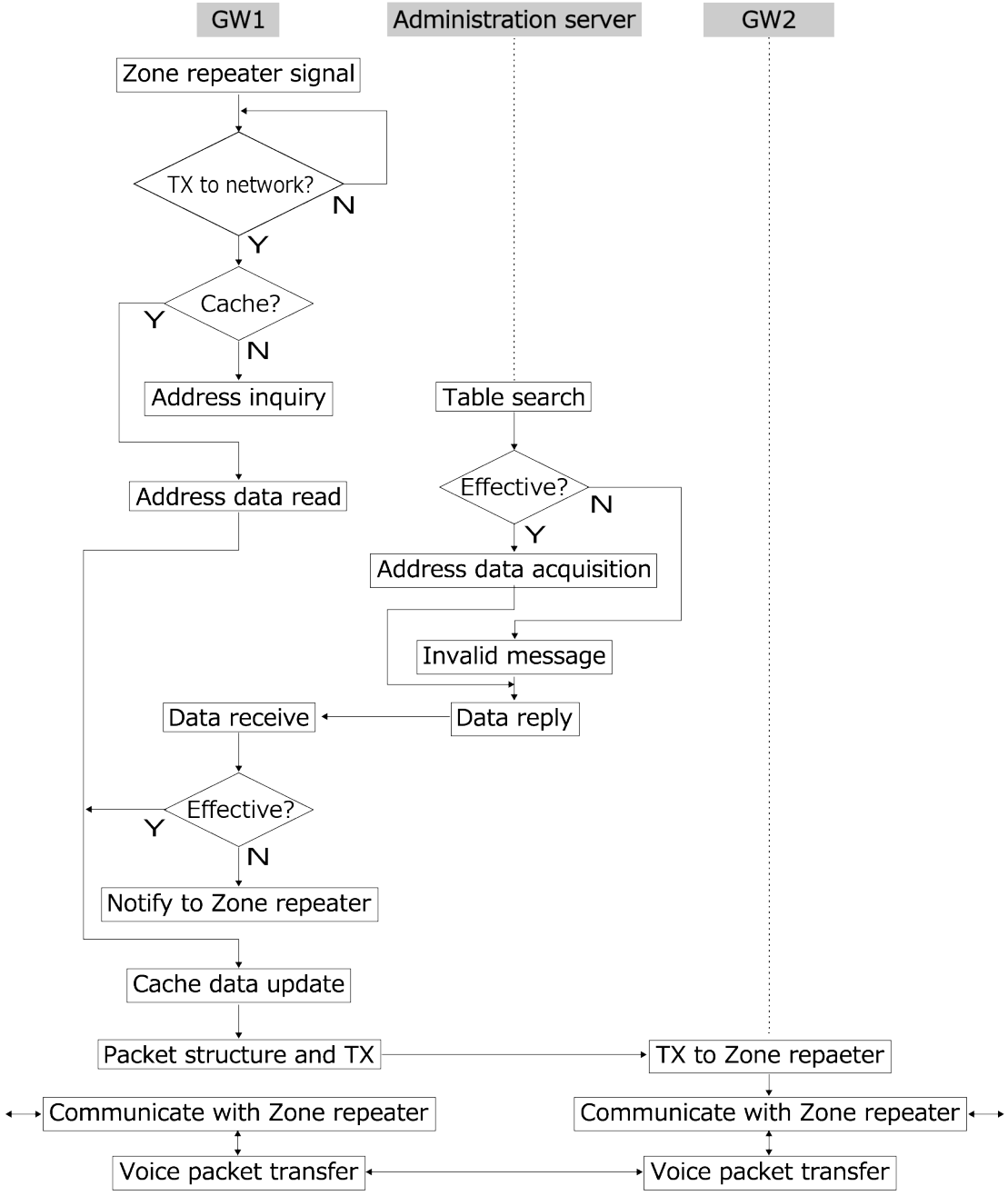


4.2.7 Voice Communication over the Internet

(1) Voice communication with stations on the Internet When calling a station on the Internet from a radio station in the repeater area, the following procedure is used.



(2) Voice communication with radio stations other than your zone (inter-zone communication)
Communication with terminal radio stations in repeater areas other than your zone through the Internet is performed as follows.



4.2.8 Communication with Analog FM

(1) Configuration

The current FM voice connection to D-STAR is made possible by attaching an adapter to the FM radio and adding a radio header packet to the beginning of the transmission signal. The received radio header retrieves and displays the callsign information necessary for the connection, such as the destination station and the repeater station.

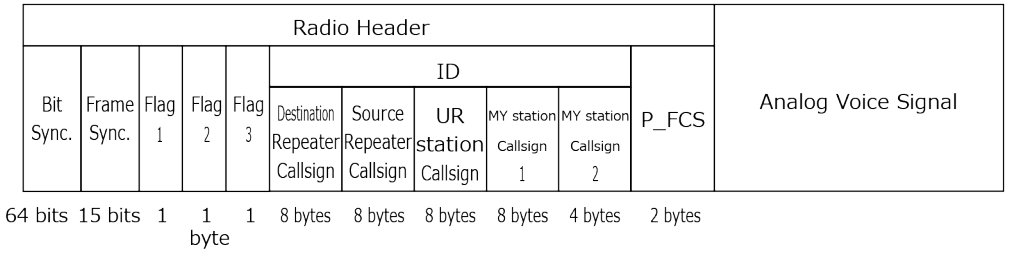
At the repeater site, an adapter is attached to the analog FM repeater equipment, and the respective call signs are extracted and reconstructed into voice packets, which are then connected to the D-STAR controller for communication. The analog audio signal from the analog FM repeater is digitized by the CODEC and inserted into the audio frame of the voice packet.

On the other hand, call sign information is extracted from voice packets sent from the controller, the radio header is reconstructed, and transmitted.

The digital audio signal extracted from the voice packet is converted back into an analog signal by the CODEC and transmitted.

(2) Radio Section Header

The structure of the radio part header for analog FM communication is basically similar to that of voice packets.



The modulation of the radio header shall be MSK modulation in the voice band, with a transmission rate of 1200 bps, 1200 Hz for signal "1", and 1800 Hz for signal "0".

Chapter 5 Network Configuration Requirements

Note: This content of this Chapter is specific to Japan. It is published here to maintain alignment with the original Japanese document.

5.1 Wired Communication Packets

Each communication packet to the Internet shall be as follows. The flag area, command area, and Ver of the following packets are defined as follows.

Query ID

The value assigned by JARL for each system shall be used. (Refer to Ap.6 for the assigned ID)

Flag (16 bits)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
*	0	0	0	0	0	0	0	0	0	0	0	*	*	*	*

TX/RX flag — Error code 4 bits

0	TX (Request)
1	RX (Receive)

Code when receiving

0	Successful end
1	No data
2	Not available now
3	GW registration request
4	GW registration failed

Command (8 bits)

0 = None
1 = Updates terminal position data
2 = Inquiry keyed to terminal callsign
3 = Inquiry keyed to device IP
4 = Inquiry keyed to Area repeater
5 = Inquiry keyed to Zone repeater
6 = Registers GW IP address
7 = None

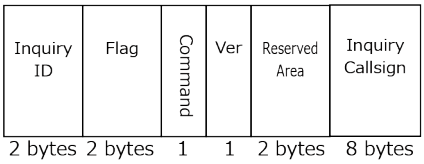
Ver. = Version and the reserved area is currently set to 0.

Note: In the field for specifying the call sign for inquiry call signs, etc., specify the actual call sign. Do not specify "CQCQCQ". Do not use anything other than alphanumeric characters (upper case). This setting is different from the setting of the radio header. Also, check the error code of the flag in the response packet to see if it has been processed successfully.

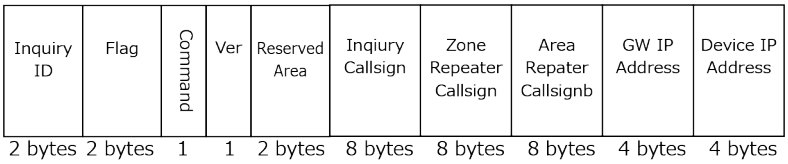
(1) Communication from the GW of the zone repeater station to the “Trust Server” (using UDP packets)

a. Inquiries keyed to call sign information from the calling station

Request packet

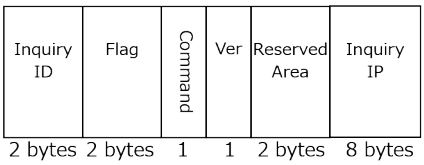


Reply packet

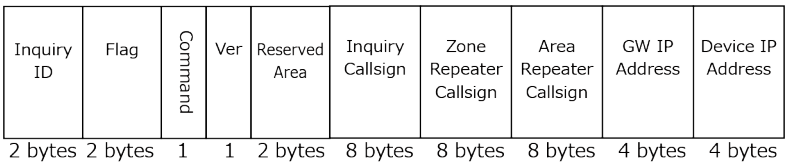


b. Inquiry request packet keyed by the device IP from the calling station

Request packet

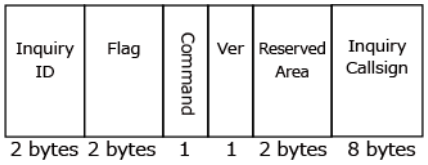


Reply packet

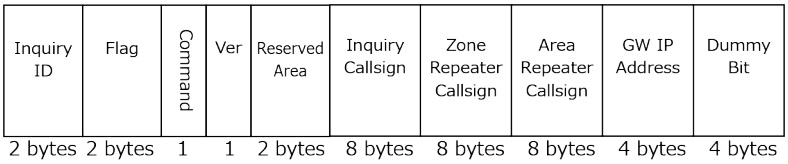


c. Inquiry request packet keyed to the area repeater from the calling station

Request packet

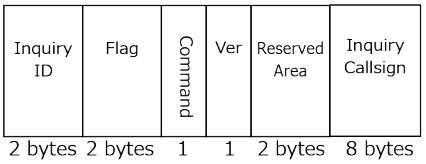


Reply packet

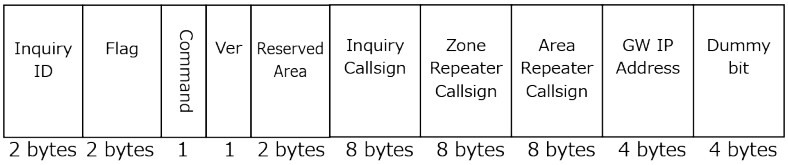


d. Inquiry request packet keyed to the zone repeater from the calling station.

Request packet



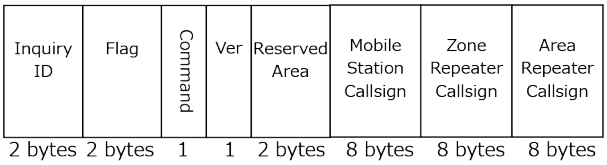
Reply packet



e. Table rewrite request from GW to “Trust Server”.

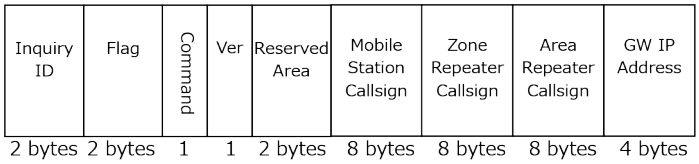
Request packet

Sends a request for rewriting to the “Trust Server” at the beginning of a call (between pressing and releasing the PTT). If there is no change in the information after that, it can be omitted.



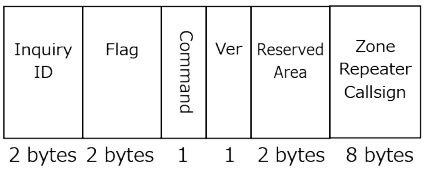
When the mobile station call sign is registered in the “Trust Server”, the “Trust Server” shall register these call signs additionally. If the mobile station call sign is registered and neither the zone repeater nor the area repeater is registered, the “Trust Server” shall register these call signs additionally. A blank space shall not be specified.

Reply Packet



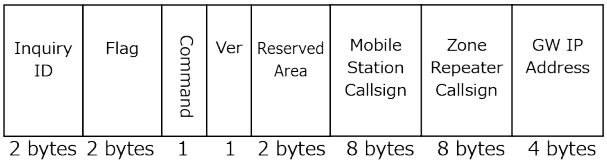
f. Request to register the IP address of GW

Request packet



Note This request should be used only when you are registered as a GW (Zone Repeater) in the Trust Server.

Reply Packet



If the station is not registered as a GW (Zone Repeater), it returns 4 as an error code.

(2) Access from a station on the Internet to a terminal radio station through a GW

When accessing a terminal radio station from a station on the Internet via the GW, the packet transfer described in Chapter 8 shall be used. When using software with a GW function, use the procedure described in 5.2 "Communication between the GW of the calling station zone repeater station and the GW of the other station zone repeater station".

When connecting to the existing JARL D-STAR network, the verification and approval of JARL shall be obtained to ensure the consistency with the existing network. In addition, the inquiry ID assigned by JARL shall be used.

(3) Communication between Zone Repeater and GW (using UDP packets)

The packet of the communication between the zone repeater and the GW is composed as follows. The management data and the contents of the trunk header of each packet are as follows. For the port number, it should be possible to specify a different number for sending and receiving. (The same number is also included.)

M = Magic Number (2 bytes) An arbitrary number, different for each packet, used to identify the packet sent in the communication between the zone repeater and the GW, and acknowledged as having been received by sending this number back.

SR = Identification of sending/receiving (1 byte)

Sending "s (0x73)", response "r (0x72)"

C = Command indicating the type of packet (1 byte)

0x00 = Dummy Connection check

0x01 = Reserved

0x10 = Reserved

0x11 = Data communication (DD) packet

0x12 = Voice communication (DV) packet

0x20 = Reserved

0x21 = Terminal location information update packet L = Data length 2 bytes)

This property indicates the data length after this.

The contents of the trunk line header are as follows.
Packet type
01000000 Data communication
00100000 Voice communication
11100000 Reserved

Repeater ID
Number of the repeater site in the same zone

Terminal ID
Number of the repeater in the same repeater site
Note: In the case of a response, 0xff must be set for the source terminal ID.

Call ID
The same ID shall be set during a call (between pressing and releasing the PTT). Do not overlap with other IDs. (Normally, a random number is used.)

Expansion of Bits in C (Packet Type Command) (For details, refer to "Chapter 8 Packet FORWARD".) Bits that are not defined in the above "Packet Type Command" are defined as follows. 8 bits of "Packet Type Command" shall be defined as follows.

GZIIXFII (Each bit is indicated by a symbol)

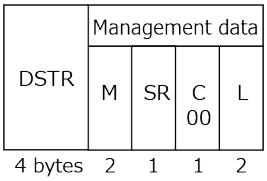
G FORWARD packet flags for packets from/to gateways
Z Flags of packets from/to zone repeater for FORWARD packets
X Control command for xchange from FORWARD port
F Packets from other FORWARD ports
I Defined in previous specification (used in Icom's dsgwd and ID-RP2C)

Note: These bits are not used in Icom's specification. xchange, packets to dsgwd and ID-RP2C should be forwarded with these bits cleared.
In packets from the FORWARD port, if these bits are set, it indicates packets from the corresponding bits. In packets to the FORWARD port, if these bits are set, send to the respective port. In the case of a retransmitted packet from a FORWARD port to another FORWARD port, the second bit shall be set. (See the explanation above.)

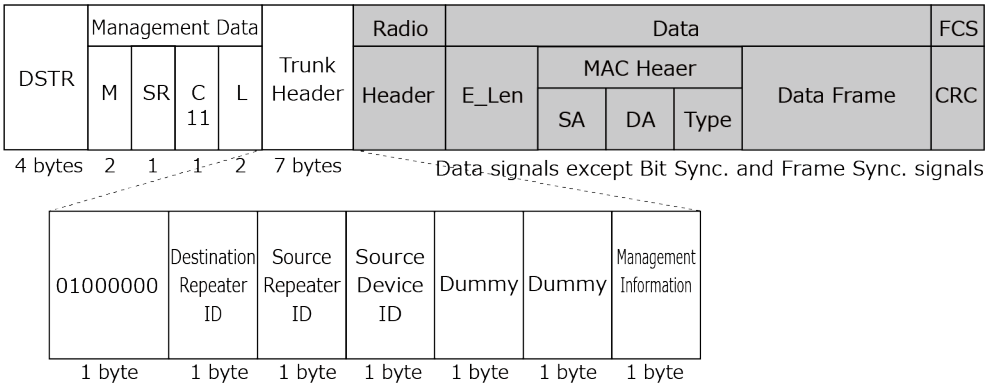
In the communication between the zone repeater and the GW, the M (magic number) and SR (send/receive identification) are used to confirm the communication. The sender sets the transmission order number in M and s in SR, and sends the message.

The receiving side compares the received transmission reception number with the transmission order number received just before it, confirms that there is no omission, and sets the received number in M, r in SR, the received value in C, and zero in L. After receiving this confirmation, the sender increases M by one and sends the next information.

a. Dummy packet

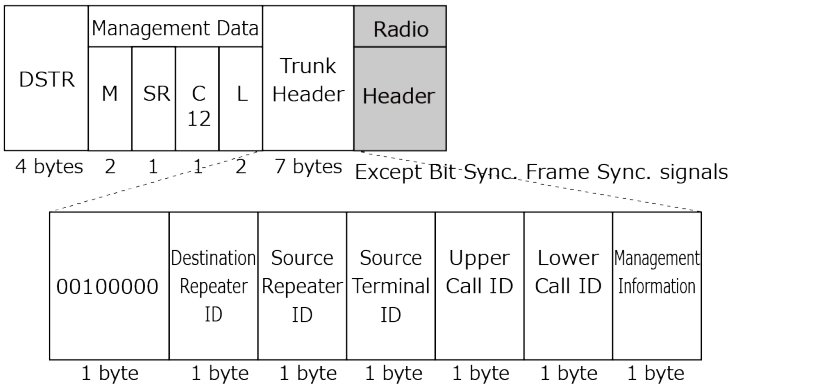


b. Data

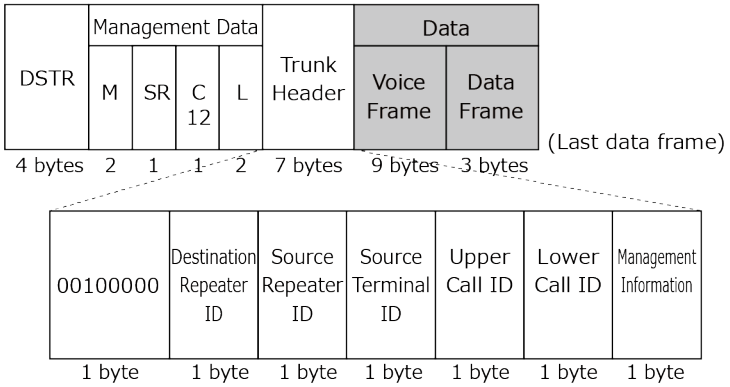


c. Voice data

Radio Header



Data



Call ID

Identification of voice packets in one communication (2 bytes, 16 bits), assignment of the same number to multiple packets in the same communication by a random number. The same communication means a single communication by PTT.

Administration Information

Management Information

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Frame Type		Error	*	*	*	*	*

Voice Packet Sequence Numbers
(Sequencially assigned to Voice Packet. (0 to 20))

00 = Voice Communication Data
01 = Voice Communication Data(last frame)
10 = Voice Communication Radio Header
11 = Reserved

1 = Header error
0 = Normal

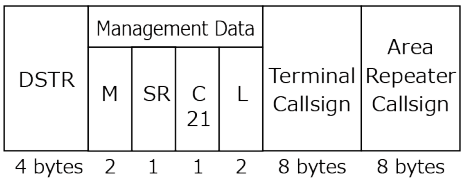
Recommendation:

A radio header shall be inserted every 21 times of voice data (immediately before the voice data in which the resynchronization signal is inserted) in consideration of the packet loss of the voice header. However, the transmission interval of voice data shall be maintained at 20 msec. If the receiving side has already received the radio header, the subsequent radio header shall be discarded.

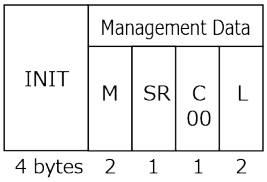
d. Error data

DSTR	Management Data				Error Data
	M	SR	C 01	L	
4 bytes	2	1	1	2	

e. Terminal location data

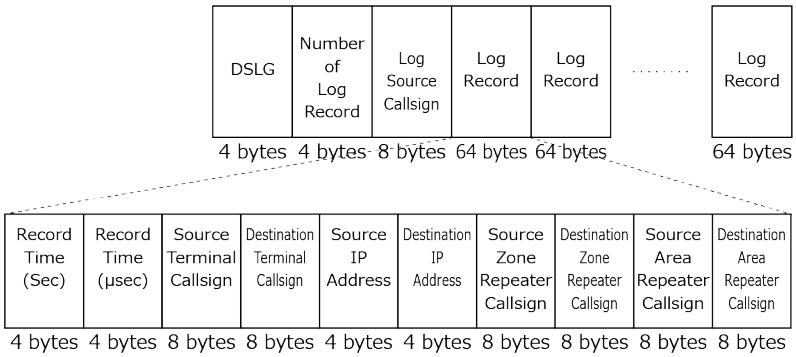


f. Initialization packet



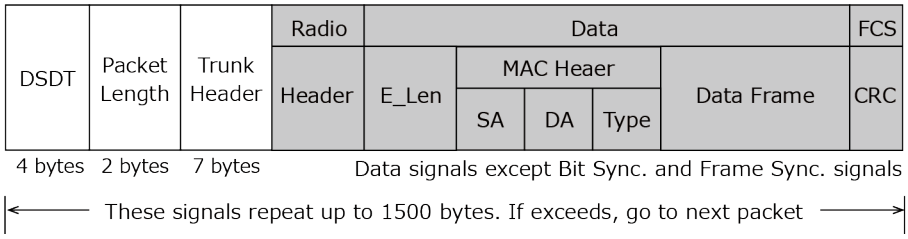
Used to initialize the M (magic number) value when it no longer matches between the GW and the zone repeater.

(4) Transfer of log data from the GW to the "Trust Server" (using TCP/IP packets)



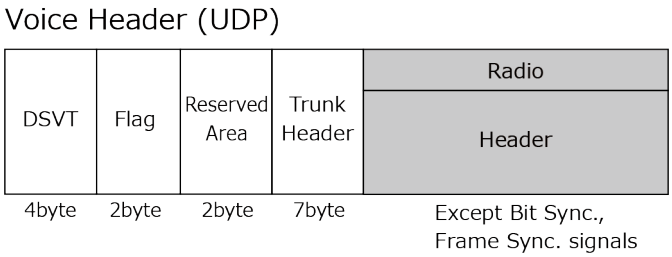
5.2 Communication between GW of calling station zone repeater station and GW of peer station zone repeater station.

a. Data communication (TCP/IP)

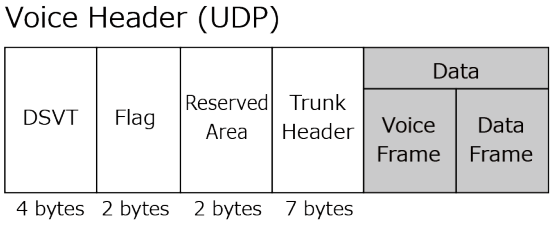


b. Voice communication

Voice header (UDP)



Voice data (UDP)



Flag (2 byte)

Flag (2 bytes)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
*	*	*	*	–	–	–	Reserved Area				–	–	–	–	*

0001	Radio Header Packet
0010	Data Packet

0	Hole Punch OFF
1	Hole Punch ON

When the hole punch bit of the received DV header (radio header) packet is ON, it shall send the source terminal call sign, or in the case of sending to the source GW IP address, the source UDP port number as the peer port.

5.3 "Trust Server”

The administrator of the "Trust Server" assigns an IP address to the user applicant through its input system and registers him/her in the server.

5.3.1 Management Table of Call Sign and IP Address

When the " Trust Server " receives a call from the GW of the "zone repeater station" through the Internet, it searches the table and returns the necessary data. The contents of the administration table are as follows

“Trust Server” administration table

Management Table of Trust Server

Zone GW IP Address (Global GW IP Address)	Zone Repeater	Area Repeater	Terminal Name	Callsign	Device IP Address (Private IP Address)	Remarks
12.34.56.78	J$1TTT	J$1TTT	Alpha	J$1QQQ□F	10.1.0.56	Device a
12.34.56.78	J$1TTT	J$1TTT	Lisa	J$1QQQ□F	10.1.0.57	Device b
12.34.56.78	J$1TTT	J$1TTT	Copy	J$1QQQ□E	10.1.0.58	Device c
12.34.56.78	J$1TTT	J$1TTT	Camera	J$1QQQ□D	10.1.0.59	Device d
12.34.56.78	J$1TTT	J$1TTT	―――	J$1QQQ□A	203.138.200.20	Global IP
12.34.56.78	J$1TTT	J$1TTT	―――	J$1QQQ	―――	Voice
12.34.56.78	J$1TTT	J$1TTT	A	J$1NNN□F	10.1.34.66	Device a
12.34.56.78	J$1TTT	J$1TTT	―――	J$1NNN	―――	Voice
12.34.56.78	J$1TTT	J$1TTT	A	J$1OOO□F	10.1.34.76	Device a
12.34.56.78	J$1TTT	J$1TTT	B	J$1OOO□E	10.1.34.77	Device b
12.34.56.78	J$1TTT	J$1TTT	―――	J$1OOO	―――	Voice
23.45.67.89	J$1VVV	J$1SSS	A	J$1WWW□F	10.1.90.12	Device a
23.45.67.89	J$1VVV	J$1SSS	B	J$1WWW□E	10.1.90.13	Device b
23.45.67.89	J$1VVV	J$1SSS	―――	J$1WWW	―――	Voice
12.34.56.78	J$1TTT	J$1TTT	Server		10.1.88.01	Server
↓	↓	↓	↓	↓	↓	↓

5.3.2 Communication Logging System

The communication log system is a system to periodically record the contents of inquiries received from "zone repeater stations". The contents to be recorded are as shown in the following communication log.

If each GW has a cache function, it should be in accordance with the time interval of this communication log. In other words, the system should always query the " Trust Server" at regular intervals and record the contents of the query as the communication log.

Example of communication log

Example: Communication Log Record

Date and Time		Zone GW IP Address	Zone Repeater	Area Repeater	Terminal Callsign	Device IP Address	UR IP Address
030325	15:25	12.34.56.78	J$1VVV	J$1SSS	J$1WWW□F	10.1.90.12	Device a
030326	15:27	23.45.67.89	J$1VVV	J$1SSS	J$1WWW□E	10.1.90.13	Device b
↓		↓	↓	↓	↓	↓	↓

Chapter 6 Data Frame

The data frame defined in the voice packet frame shall conform to the following specifications, which do not restrict any usage not defined in this specification. The part of the GPS message defined in this specification that conforms to APRS shall be referred to as D-PRS.

Note: Icom holds a patent (in Japan only) on the selection of code squelch and GPS messages, but Icom has kindly agreed to make this information available to the public. However, it is necessary to conclude a contract with Icom for the use of these patents. (See attached sheet)

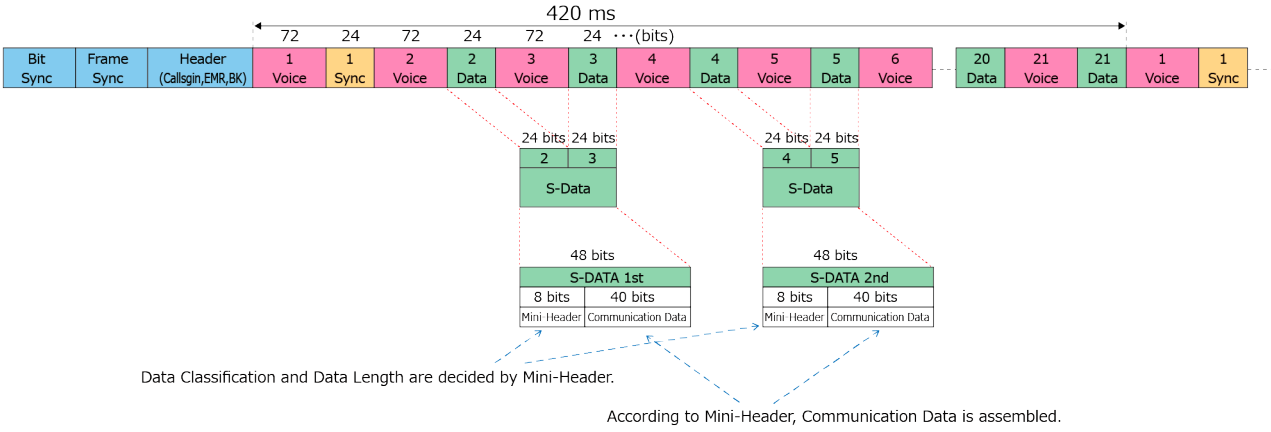
6.1.1 Mini-header

Since the data frame is as small as 24 bits, two data frames are joined together and used as communication data. The first byte of the data frame is used as a mini-header to identify the data type when the data frames are joined together.

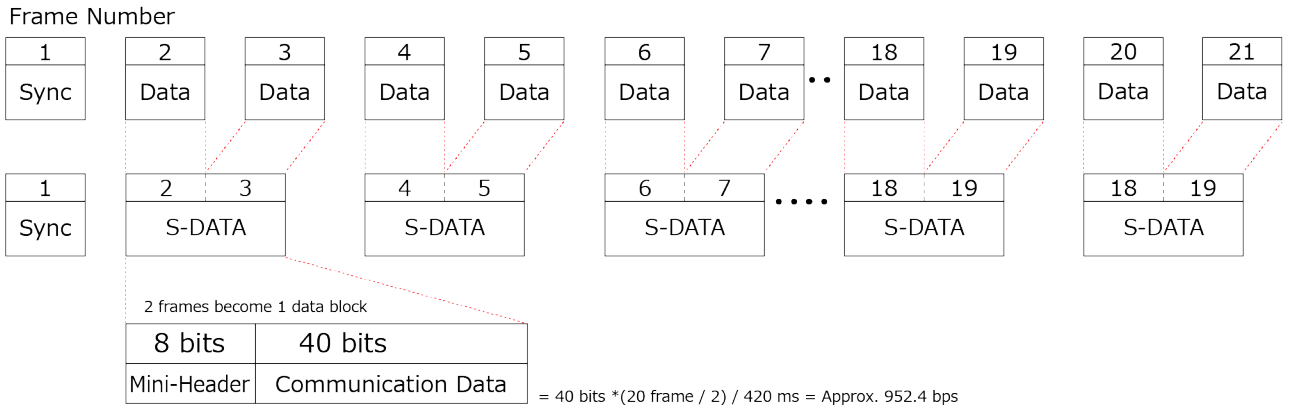
6.1.2 Data frame joining rules

For data frame joining, two data frames are concatenated and used as a single data block (48 bits).

Whole Frame



Excerpt of data frame only



The first 8 bits of the block indicate the data type and data length. This 8-bit is called a mini-header. For this reason, the communication speed by this method is about 950bps.

6.1.3 Mini-Header Assignment

Mini-Header List

Header Number	x Range (bytes)	Purpose	Function and remarks
0x	------	Reserved	------
1x	------	Reserved	------
2x	------	Reserved	------
3x	1～5	Simple Data Communication	Used for character forwarding of data communication from user PCs. D-PRS data communication is treated as simple data communication. * Range represents the number of valid letters per one block.
4x	0～3 Block Number	Message function	Used for messages that are communicated only by radios. * Only message function represents data block numbers.
5x	1～5	Radio Header resending	Resends Radio Header.
6x	------	Reserved	------ * Except x=6
66	------	No Data	Represents “No Data” in Data Frame
7x	------	Reserved	------
8x	1～F	Fast Data	Represents Fast Data Length 1 byte to 15 bytes.
9x	0～C	Fast Data	Represents Fast Data Length 16 bytes to 28 bytes.
Ax	------	Reserved	------
Bx	------	Reserved	------
Cx	2	Code Squelch	Two-digit code of Code Squelch.
Dx	------	Reserved	------
Ex	------	Reserved	------
Fx	------	Reserved	------

When there is no data in the data frame, the data-free part 0x66 is embedded.

Reserved: Reserved for special use or to be used in the future.

For 8 x and 9 x, refer to "Chapter 7 Fast Data".

6.2 Simple data communication

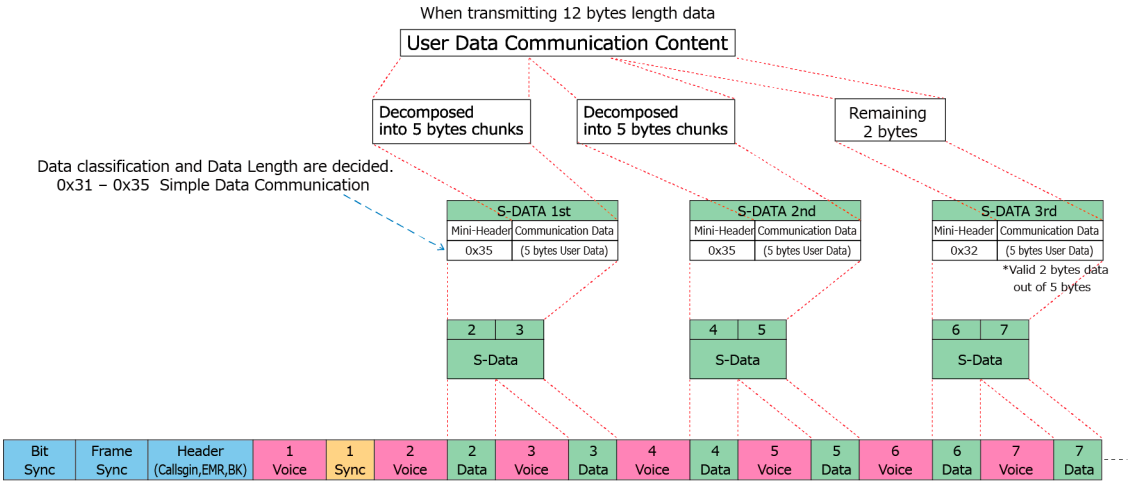
When communicating using the "Simple Data Communication" mini-header, the following characters cannot be used.
0x00
0x11 (XON)
0x13 (XOFF)
0x76 (XOFF)
0x84 (Used for packet loss notification Note 1)
0xE7 (Used for packet loss notification Note 1)
0xFE (Used for packet loss notification Note 1)

Note 1: This function cannot be used because it is treated as a packet loss when the data frame is a data sequence of "0xE7, 0x84, 0x76" and the voice frame is a silence pattern of "0x9E, 0x8D, 0x32, 0x88, 0x26, 0x1A (See "6.6 Packet Loss.")

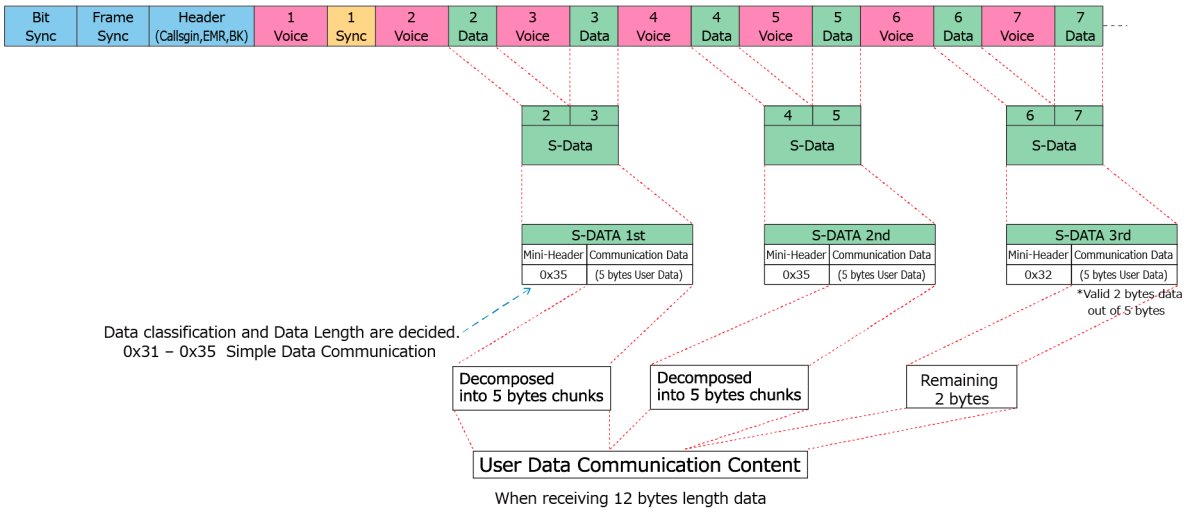
Example of data configuration on the sending/receiving side when transferring user's data communication by simple data communication.

Example of inserting the user's data communication content into the radio format at the sending end.

Example: Inserting user data communication content into Radio Format at caller side.



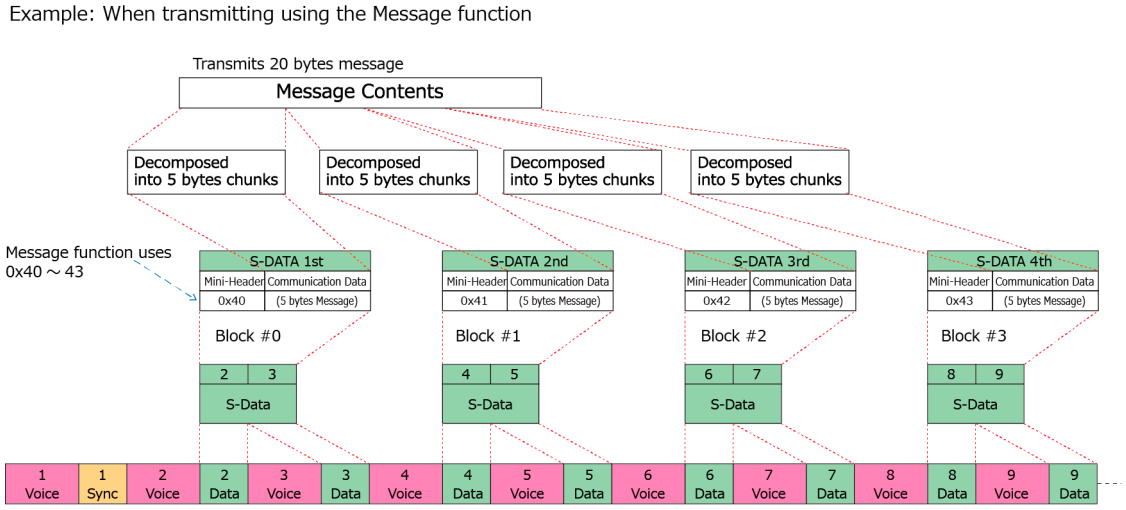
Example: Inserting user data communication content into Radio Format at called side.



6.3 Simple Messages

This section describes how to send and receive 20-character messages on the radio display. The characters that can be used depend on the radio in use.

Example of sending a message function



In the above example, the message content is transmitted from "2 Data (data frame 2)" immediately after "1 Sync", but message transmission can also be started from an even number of data frame positions such as "4 Data", "6 Data", or "8 Data".

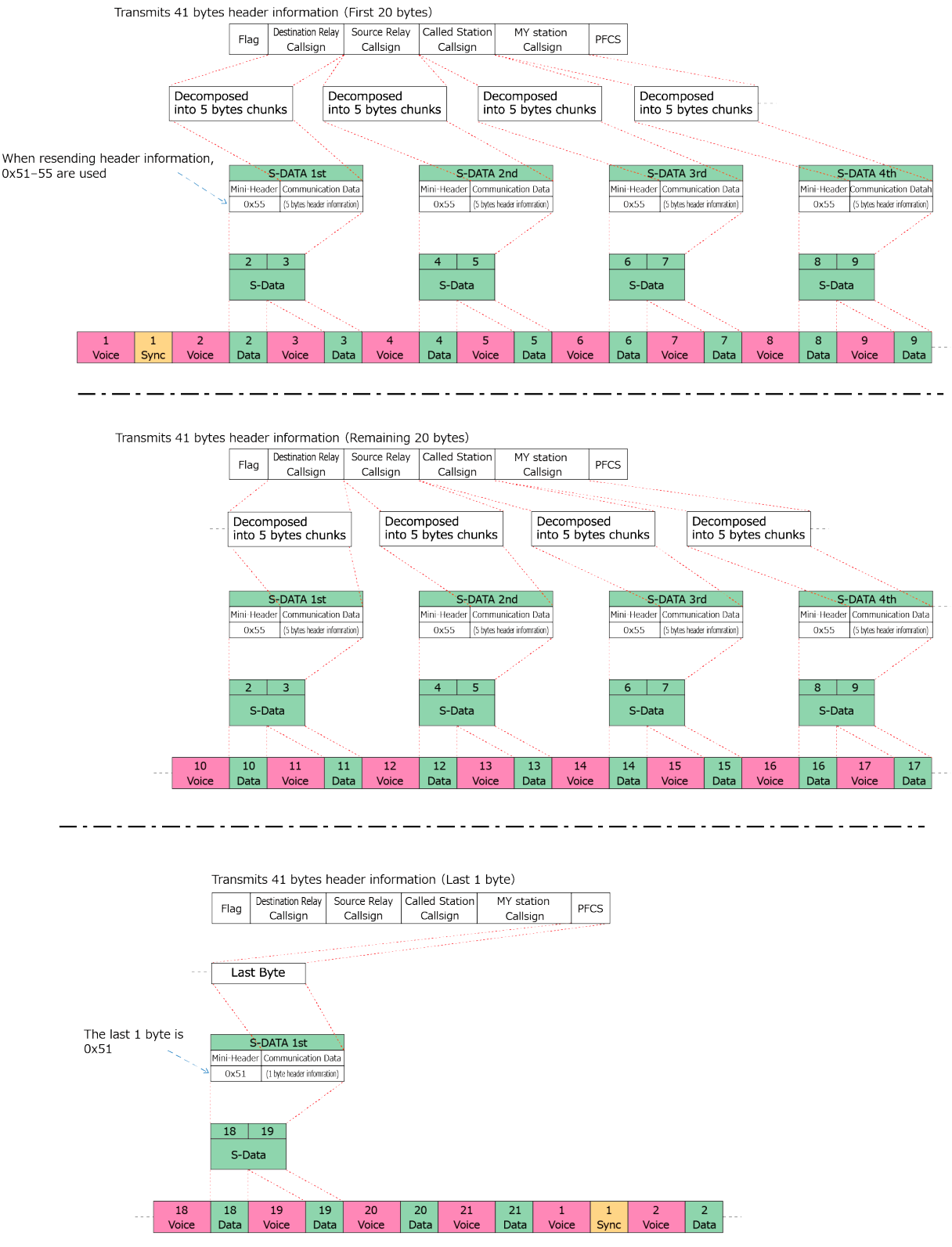
6.4 Header information retransmission

A data frame can be used to transmit the radio part header information without error correction except for bit synchronization and frame synchronization. When transmitting, a data frame of 9 frames shall be occupied after the [Sync] frame (or after that if code squelch information is to be transmitted), and one header information shall be transmitted in 420 ms cycles.

Note: Since the header information retransmission occupies a high percentage of the data frame, header information retransmission may not be performed when the user is performing simple data communication or during the period when the message of the message function is being transmitted.

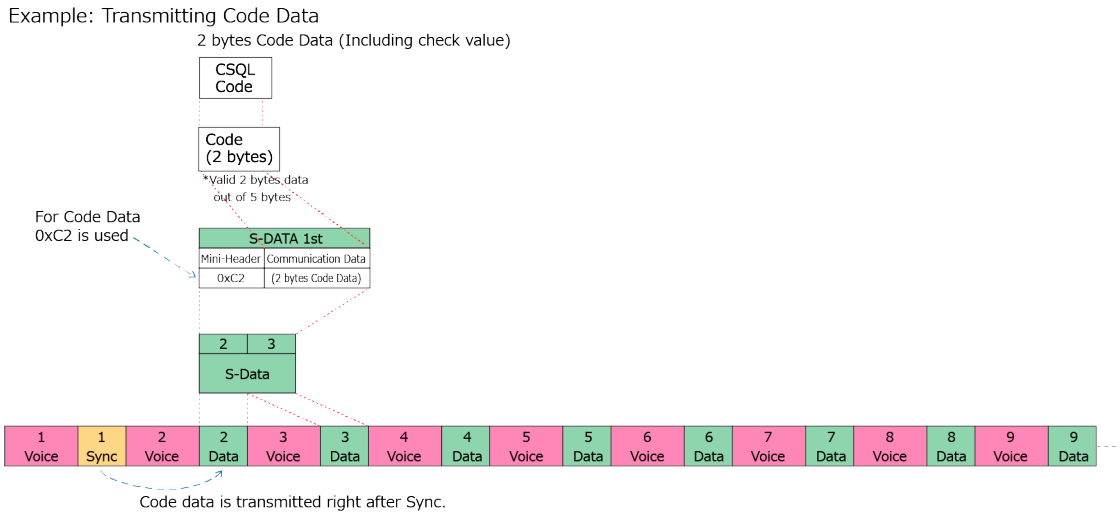
Example of header information retransmission

Example: When resending Header information



6.5 Code Squelch

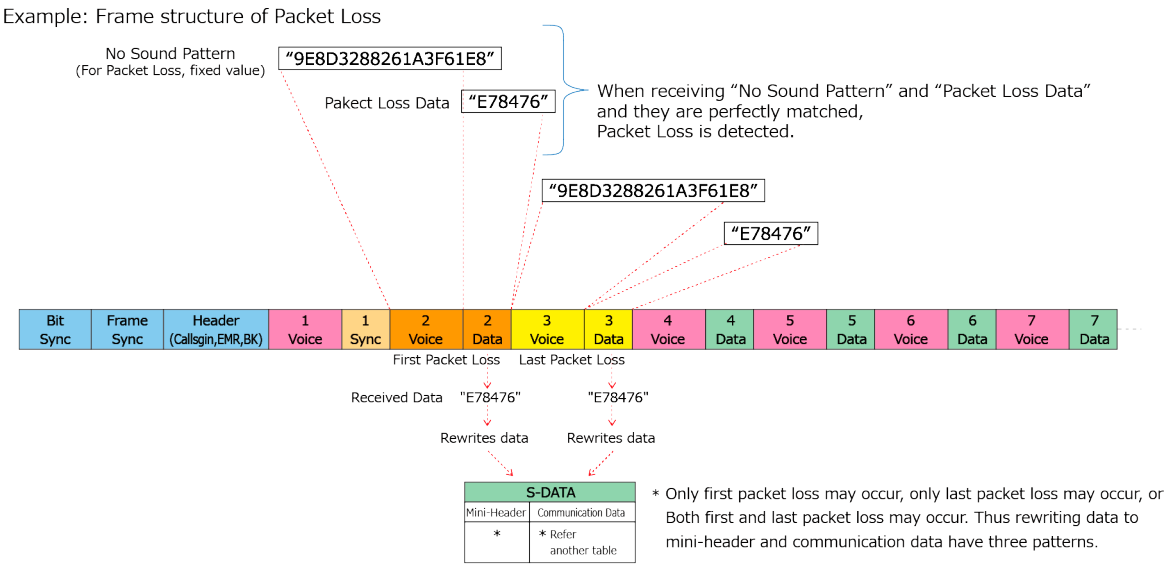
The code data used in the radio's digital code squelch (CSQL) is transmitted in data frames using the two-digit code data of the following procedure. The code data shall be transmitted in two data frames immediately after the [Sync] frame in a 420 ms cycle.



6.6 Packet Loss

If an Ethernet packet is lost somewhere in the gateway path, the packet is sent with the hexadecimal number 9E8D3288261A3F61E8 in the voice frame and the rewritten information in the data frame according to the following "Rewriting conditions for mini-headers and data in packet loss".

Example of packet loss frame configuration



Conditions for rewriting mini-header and data in packet loss state

Condition of Packet Loss	Data to rewrite		What Mini-Header represents:
	First 3 bytes	Last 3 bytes	
First frame: Normal, No Data Last frame: Packet Loss	"66 66 66"	"66 66 66"	No Data
First frame: Packet Loss (Which means Mini-Header is lost, there is no data in the last frame.)	"31 80 66"	"66 66 66"	Rewritten simple data "80"
First frame: Normal, Less than 2 bytes Last frame: Packet Loss	"31 xx 66"	"66 66 66"	Normal simple data "xx"
	"32 xx xx"	"66 66 66"	Normal simple data "xx xx"
First frame: Normal, more than 3 bytes Last frame: Packet Loss	"33 xx xx"	"80 66 66"	Rewritten simple data "xx xx 80"
	"34 xx xx"	"80 00 66"	Rewritten simple data "xx xx 80 00"
	"35 xx xx"	"80 00 00"	Rewritten simple data "xx xx 80 00 00"

Red: Rewritten Data, xx: Valid receive data

6.7 GPS Data Configuration

When transmitting by GPS, the following format shall be used.

(NMEA sentence 1) , (NMEA sentence 2) , (NMEA sentence 3),J¥1AAA-A ,TEST MESSAGE<CR><LF>

1. NMEA sentence (Max. 3 sentences) 2. Callsign 3. Message

1.NMEA Sentence, any one to three NMEA sentences can be sent.

2.Call sign (8 characters fixed, unused space is filled with space character)

3.Message (20 characters fixed, unused space is filled with space character)

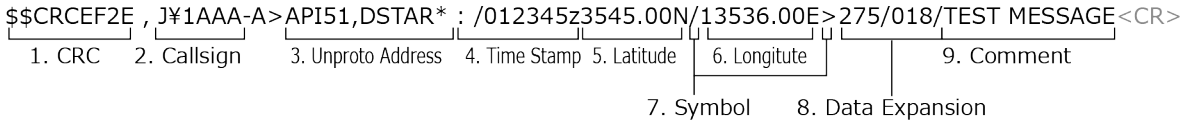
6.8 D-PRS

For D-PRS transmission, the data frame assembly of the simple data communication shall be used, and the data content to be sent in the simple data shall be in the format conforming to the APRS. The specification for D-PRS data assembly is based on the APRS specification, with the addition of CRC codes, etc. for D-STAR equipment.

The D-PRS data shall be created based on the various information input to the radio in NMEA format.

6.8.1 Composition of D-PRS data

When transmitting by D-PRS, the format shall be as follows.



In the D-PRS format string, the 1. CRC part is the part that is added by D-STAR. The part after 2. Call sign follows the APRS specification to pass I-GATE.

The D-PRS obtains and transmits the following GPS information from the NMEA sentences obtained from the GPS device.

GPS information	NMEA sentence to acquire the data	D-PRS Data situation of utilization	Remarks
Latitude/Longitude	RMC/GGA/GLL	Always used.	
Date	RMC	Time Stamp uses D-PRS data at DHM.	UTC Time
Time (Hours/Minutes/Seconds)	RMC/GGA/GLL	Time Stamp uses D-PRS data at DHM/HMS.	UTC Time, Acquires from the same sentence as Latitude/Longitude
Speed	RMC/VTG	Used when data expansion is set.	
Path	RMC/VTG	Used when data expansion is set.	
Altitude	GGA	Used when Altitude TX is ON.	

1. CRC

"$$CRC" (fixed character string) + 4 characters of CRC value shall be set.

For the CRC value, the APRS data including the call sign is calculated by CRC, and the result is converted to ASCII and used as 4 bytes of data. For the calculation method, refer to "Ap2 Error Correction and Interleaving".

2. Call sign
The SSID is added to the end of the call sign and is sent out.

Example
J$1AAA(No SSID)
J$1AAA-A ～ J$1AAA-Z
J$1AAA-1 ～ J$1AAA-15

The SSID to be added to the call sign (indicating the operation type of the station) shall be one of -A to -Z or -1 to -15.

3. Unproto Address
The format recommended by the APRS governing body shall be used.

APxyyy,DSTAR*
"x" indicates the manufacturer.
The "yyyy" indicates the manufacturer's unique symbol.

4. Time Stamp
The time stamp can be selected from three types, and the time must be set to World Standard Time.
・Do not add a time stamp (OFF)
・Add a time stamp for the date, time and minute (DDHHMMz)
・Add a time stamp for the hour, minute, and second (HHMMSSh)

The delimiter character is different when a time stamp is added and when no time stamp is added. (See example.) If time information is not obtained, fill in all digits with "_".
Example:
For date, time and minutes "/010710z" (Universal Time: 07:10 on 01 (day))
For hours, minutes and seconds: "/072130h" (07:21:30 UTC)
No timestamp "!": (separator to indicate no timestamp)

5. Latitude

Latitude information obtained from either RMC/GGA/GLL sentences of GPS is used. The latitude information is fixed in the following format in degrees and minutes, and is not zero suppressed. (The GPS latitude format setting is not followed, and the information is sent in the fixed degree/minute format.)

Example

d d M M . mm N (DMS up to Second decimal place)
↑ ↑ ↑
Degree Minute North or South

Example: 0123.50S → Latitude South 1°23.5'(Latitude South 1°23'30")

6. Longitude

The longitude information shall be obtained from one of the RMC/GGA/GLL sentences of GPS. The longitude information is fixed in the following degree format, and no zero suppression is performed. (It does not follow the format setting of GPS longitude, but is transmitted in fixed a degree format.)

Example

d d d M M . mm E (DMS up to Second decimal place)
↑ ↑ ↑
Degree Minute East or West

Example: 01234.50W → Longitude West 12°34.5'(Longitude West 12°34'30")

7. Symbol

The symbols used shall conform to the APRS data rules. Alphabet, numbers, symbols, spaces, etc. can be used. (Refer to "Ap3 Symbols to be used in D-PRS"). In addition, a symbol to clearly indicate the type (identity) of the transmitting station shall be added to the D-PRS data.

8. Comment

Path/speed can be added as extended data to D-PRS data. Adding the path/speed as extended data reduces the number of characters that can be sent in the D-PRS comment by 7 characters.

The user can freely add comments when sending D-PRS data. The maximum comment length varies depending on the "Data Expansion" and "Altitude" settings.
The comment character length for each combination of the number of characters of the comment to be added to the D-PRS data is as follows.

Data Expansion	Altitude	Comment Length
No	No	43 letters
No	Yes	35 letters
Path/Speed	No	36 letters
Path/Speed	Yes	28 letters

9. Altitude

In the D-PRS specification, the altitude information is added before the comment.

Example

When using the altitude setting, set the altitude in the form of "A=000000" before the comment. 000000 is fixed to 6 digits and set in field. The transmittable range is -99999 to 999999 feet. If the altitude is negative, the string will be something like "A=-00123".

Chapter 7 Fast Data

When a voice frame is used as data, it shall conform to this definition. In addition, when the PTT is pressed, the transition shall be made so that the voice is transmitted as a normal voice frame immediately.

7.1 Frame Assembly for Fast Data

Fast data is similar to the formatting rules for conventional simple data, with the only differences being the handling of voice frames and the assignment of mini-headers (see Chapter 6). For connecting voice + data frames for Fast Data communication, the D-STAR DV radio format has Sync frames in 420 ms cycles, and the Fast Data, data blocks should also be managed with block numbers from 1 to 10, which cycle once in 420 ms. The first block that contains the Sync frame shall be managed as a block number from 1 to 10.

Only the first block (block number 1), which contains the Sync frame, is different in length from the other blocks (block numbers 2-10). When it is necessary to switch to audio, the data block of normal slow data (block containing audio data) shall be used to switch at the end of each block of fast data.

However, a beep sound indicating fast data shall be inserted periodically for a period of approximately one second. The insertion of the beep sound shall be achieved by switching to the slow data, data block at the end of each block of fast data. (For details, refer to "7.5 Beep sound indicating fast data and switching data blocks.) When transferring data in this way, a transfer rate of approximately 3480 bps can be obtained.

7.2 Relationship between Fast Data Radio Format and Block Number

7.3 Fast Data Block Assembly

Only the block containing Sync (block number 1) has an effective data length of 28 bytes (224 bits).

Details of Data Block Structure including Sync Frame

2nd data		3rd data		2nd Voice			3rd Voice			1st Voice		
4 bytes (Valid Data)				24 bytes (Valid Data)								
1 byte	2 bytes	1 byte	2 bytes	4 bytes	1 byte	4 bytes	4 bytes	1 byte	4 bytes	4 bytes	1 byte	4 bytes
Mini-Header	Data	Guard	Data	Data	Mitigation	Data	Data	Mitigation	Data	Data	Mitigation	Data

Guard: A guard bit to prevent false detection of packet loss, and an arbitrary value that does not match the packet loss pattern.
Mitigation: A bit to mitigate vocoder noise at the receiving side when received by an existing model. Always assign 0x02.

Blocks that do not contain Sync (block numbers 2 to 10), with an effective data length of 20 bytes (160 bits).

Details of Data Block Structure excluding Sync Frame

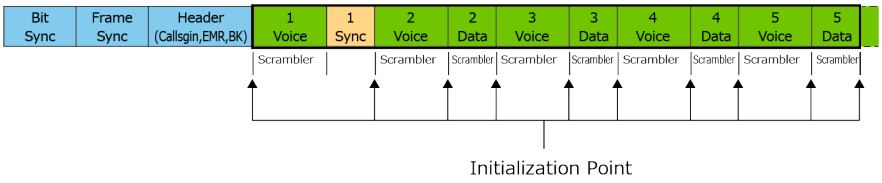
4th data		5th data		4th Voice			5th Voice		
4 bytes (Valid Data)				16 bytes (Valid Data)					
1byte	2byte	1byte	2byte	4byte	1byte	4byte	4byte	1byte	4byte
Mini-Header	Data	Guard	Data	Data	Mitigation	Data	Data	Mitigation	Data

7.4 Data Scrambler for Fast Data

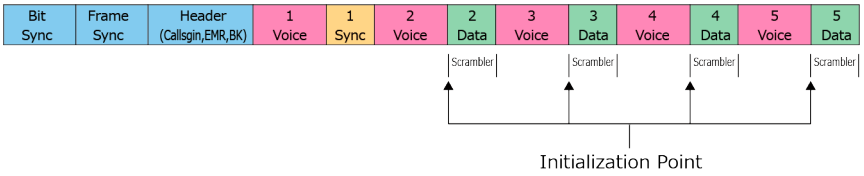
A scrambler conforming to the specifications in "Ap1. Scrambler" shall be applied to the frame area where the fast data is transferred.

Range scrambling can be applied

Scrambling range and initialization point when sending fast data



Scrambling range and initialization point for voice transmission



7.5 Beep sound indicating fast data and switching of data block.

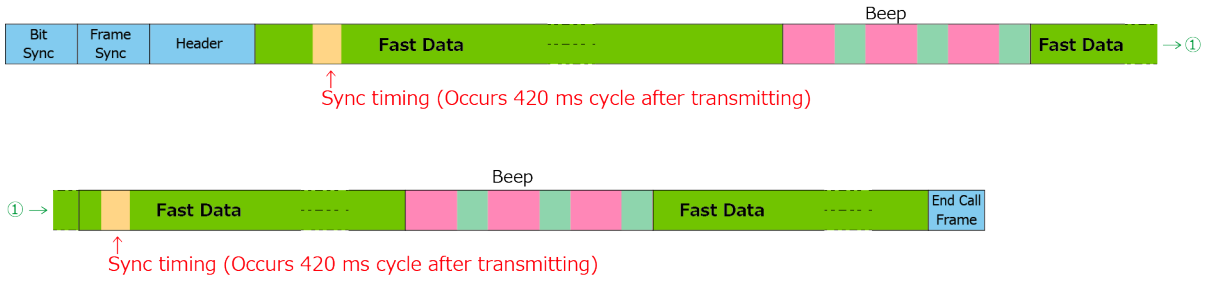
During the communication of fast data, a beep sound shall be periodically placed on the voice frame for about one second.

7.5.1 Example of switching between fast and slow data transfer rates

The order of voice frames and data frames in the radio format for normal voice communication.

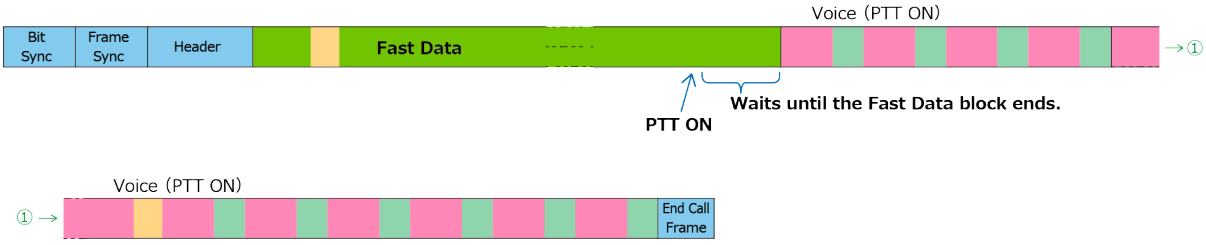
When a beep sound is periodically made during the fast data communication (fast → slow → fast → slow...)

At the end of the data block of the fast data immediately before the beep sound, the communication shall be switched to voice communication for the beep sound and the beep shall be made. After the beep is finished, it shall switch to the fast data block again

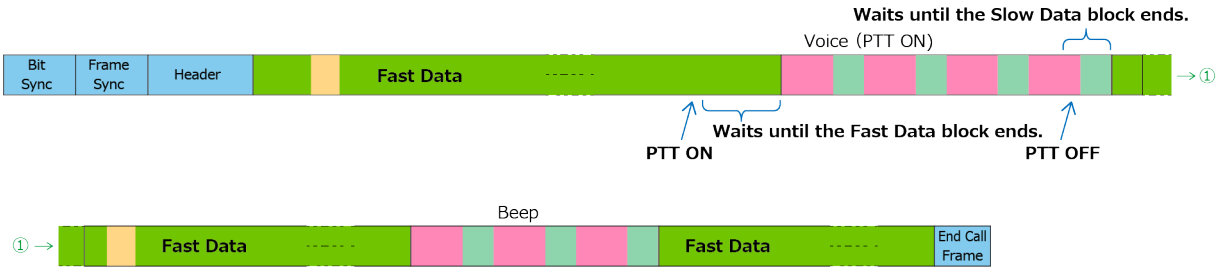


When the PTT is turned on during fast data communication (Fast → Slow)

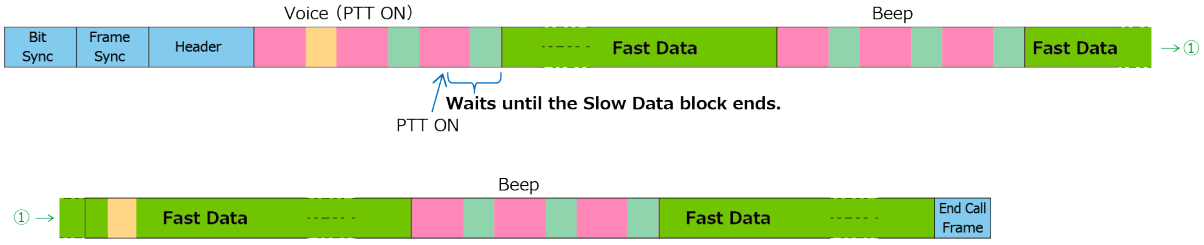
After the PTT is turned on, at the end of the data block of the fast data, it shall be switched to voice communication by PTT operation.



When the PTT on → PTT off operation is performed during fast data communication (Fast → Slow → Fast), after the PTT is turned on, at the end of the fast data, data block, the PTT operation shall switch to voice communication. After the voice communication is finished, the PTT is turned off, and at the end of the data block of the slow data, the transmission of the fast data is switched back again.



When performing fast data transmission when the PTT is turned off after voice communication has ended (slow to fast), this function is used when high-speed data transmission is desired for a certain period of time after the PTT is turned off, such as in radio applications. (For example, to transmit GPS data when the PTT is off)



7.6 Coexistence of transmission of existing mini-headers and fast data.

For details on mini-headers, refer to "6.1.3 Allocation of mini-headers".

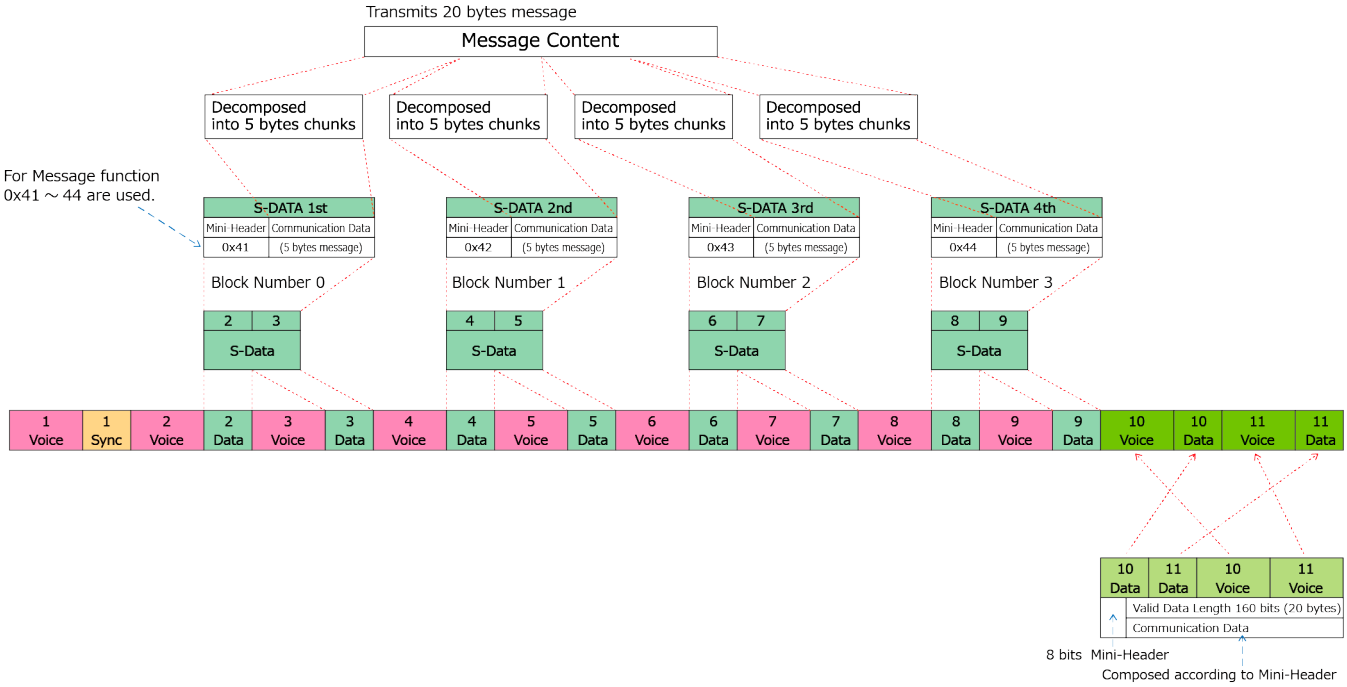
Simple data communication (mini-header number 3)

For details on the timing of switching between sending the mini-header and sending the fast data, refer to "7.5 Beep sound indicating fast data and switching the data block”.

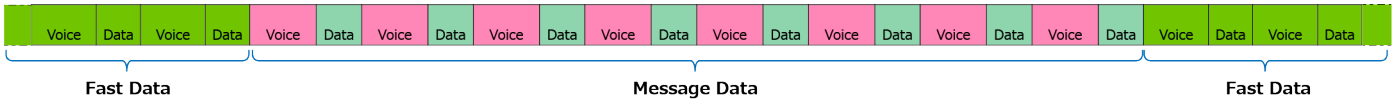
Message function (mini-header number 4x)

During the transmission of the mini-header of the message data function, the transmission of the fast data shall be suspended and the transmission of the message function shall be given priority.

Relationship between message and fast data in radio format (at the start of transmission)



Example of sending a message periodically during fast data transmission.



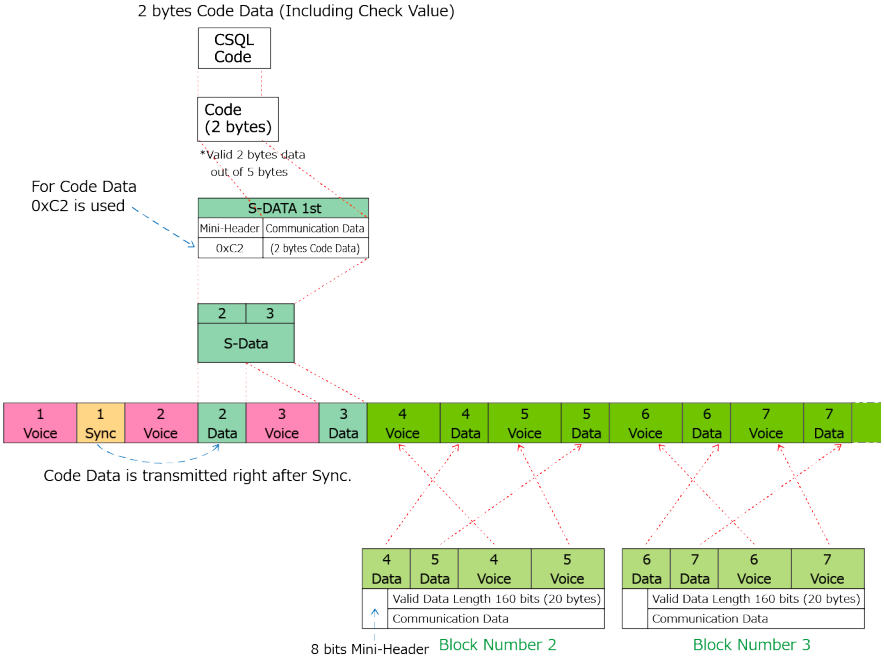
Radio header retransmission (mini-header number 5x)

Radio header retransmission is not performed during transmission of fast data.

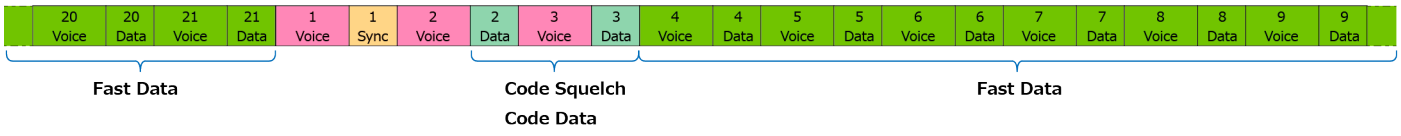
Code squelch (mini-header number Cx)

While transmitting the mini-header of the code squelch, the transmission of the fast data shall be suspended and the transmission of the code squelch shall be given priority.

Relationship between code data and fast data of the code squelch in the radio format (at start of transmission)



Example of sending the code data of the code squelch periodically during fast data transmission.



Chapter 8 Packet Forwarding

Note: This content of this Chapter is specific to Japan. It is published here to maintain alignment with the original Japanese document.

8.1 About Transferring

The transfer port is a function that allows users to read and write the communication between the zone repeater and the GW at a regular input/output destination, instead of having to read it using packet capture. This allows users to develop their own applications.

```
STD5.0 or earlier
Internet <-> dsgwd <+> ID-RP2C <-> RF
                    |      |
                    |      +-> dxchange <-> aprs server
                    +-> DPLUS, DCS etc.
                capture
STD 6.0 or later
Internet <-> dsgwd <-> xchange <-> ID-RP2C <-> RF
                           |
                           +-> dprs <-> aprs server
                           +-> datatus -> Access Display Program
                           +-> multi_forward   Program functions according to xchange server
                           +-> User program such as Dplus, new icom_dcs etc.
```

The format of this packet shall be in accordance with "(8) Communication between Zone Repeater and GW" in "5.1 Wired Communication Packet" of "Network Configuration Requirements" in Chapter 5. However, the following extensions shall be applied to the upper two bits (bits 7 and 6) and the lower two bits (bits 3 and 2) of C ("Command indicating the type of packet") in the "Administration Data" of the packet. The JARL D-STAR committee is providing a program called “xchange” as an interface to support these functions.

8.2 For details of the management data in each packet

Please refer to "8. Communication between Zone Repeater and GW" in Chapter 5 "Wired Communication Packet".

M = Sequence number (2 bytes)
This is an identification number added to each packet to confirm communication between the zone repeater and xchange, GW and xchange, and xchange and application, and is usually incremented by one.
SR = "s" for sending from GW, "r" for receiving (1 byte), specified by lower case letters
C = Command for packet (1 byte), see below.
L = Indicates the data length after this (2 bytes)

Details of C:
0x00: Dummy packet
0x01: Reserved (Reserved)
0x10: Reserved (Reserved)
0x11: Data packet (Data packet)
0x12: The voice packet
0x20: Reserved (Reserved)
0x21: Location information update packet (Location information)

Bits that are not defined in the above details are used as follows. 8 bits of C are defined as follows.

GZIIXFII (Each bit is indicated by a symbol)
G: Flags of packets from/to gateways in forwarded packets
Z: Flags of packets from/to zone repeater in forwarded packets
X: Flag command to xchange from forwarding port
F: Packets from other forwarding ports
I: Defined in the old specification (used in Icom's dsgwd and ID-RP2C)

Note: These bits are not used by Icom repeaters. xchange forwards packets to Icom dsgwd and ID-RP2C with these bits cleared. In packets from the forwarding port, when these bits are set, it indicates packets from the corresponding bits. When these bits are set in a packet to a forwarding port, it is sent to the respective port. In the case of a retransmitted packet from a forwarding port to another forwarding port, the second bit shall be set. (See explanation above)

8.3 Control Command

The following control can be performed by sending control commands from the transfer port.

Control command format

Sets 0x08 to C in the management data

DSTR	Management Data				Sub Command	Parameter
	M	SR 73	C 08	L		
4 bytes	2	1	1	2	1 byte	n byte

Transfer Control Command (C 0x08)

Normally, packets are forwarded bidirectionally as in dsgwd <-> xchange <-> ID-RP2C, but by sending the following command, bidirectional forwarding can be stopped or executed. However, packets forwarded to the forwarding port will be forwarded regardless of this command. In addition, packets from ID-RP2C requesting rewriting of location information (see section "Terminal Location Data") are forwarded to dsgwd regardless of this command.

DSTR	Management Data				Sub Command 01	Parameter	Area Repeater Name
	M	SR 73	C 08	L			
4 bytes	2	1	1	2	1	1	8 bytes

Subcommands

0x01 Set the block

Parameter 0x00 Reset (bidirectional transfer possible)

0x01 Set (bidirectional transfer not possible)

Rear Repeater Name

8.4 Port Number

The usage status of the forwarding port number is as follows.

50001	DPRS
50002	dstatus
50003	multi_forward
50004 – 50099	Reserved
50100 – 50999	User defined
51000	Used by multi_forward
51001 -	Not used

When using it in a program developed by the user, the user shall submit a notification to JARL and receive an allocation.

Appendix

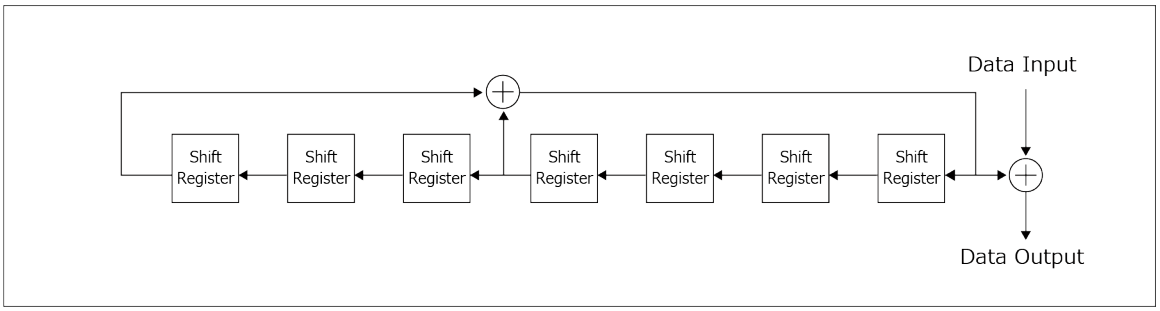
Ap1. Scrambler

Scrambling for error reduction when the same symbol is followed consecutively is done as follows.

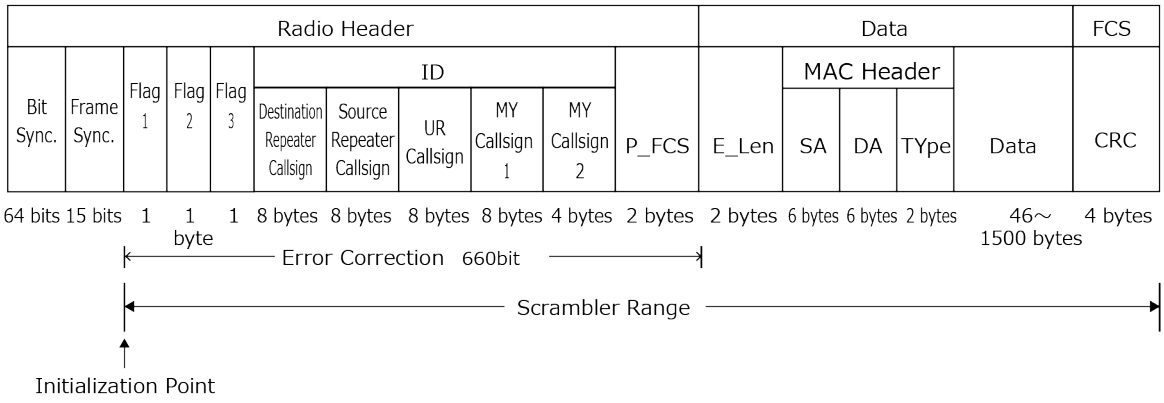
Ap1.1 Symbol of scrambler

$$S(x)=x^7+x^4+1$$

Initialization is all 1 (111111) and initialization is done at the start point of the scramble.

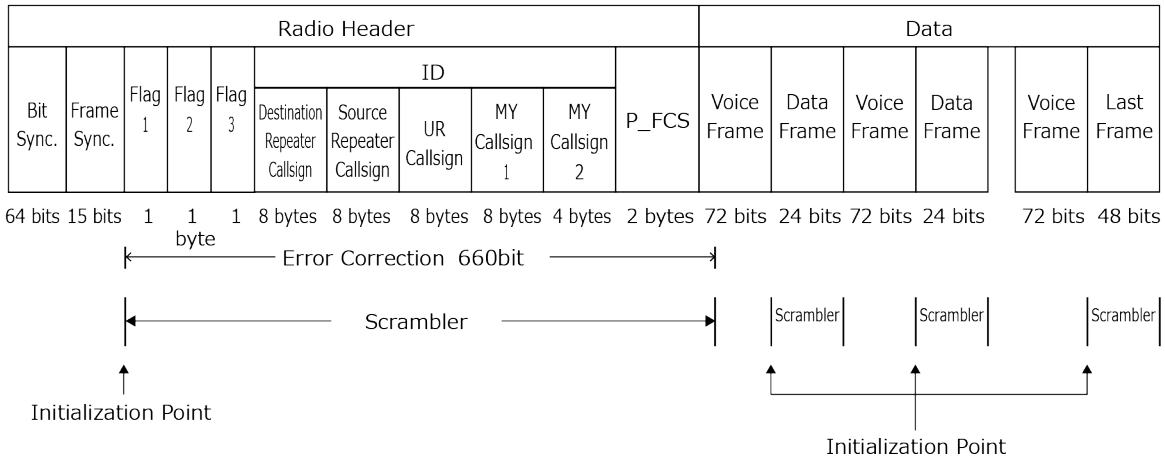


Ap1.2 Data Packet Scrambler Data packets are scrambled as follows.



Ap1.3 Scrambling of voice packets.

Voice packets shall be scrambled in the radio header and data frame except for bit synchronization and frame synchronization. However, the synchronization signal and the last frame in the data are not scrambled.



Ap1.4 Transmission Order of Symbol Sequence

When transmitting as a radio, the bit strings of each symbol shall be transmitted in the order of LSB to MSB.

Ap1.5 Frequency deviation in GMSK

Make the 1 in the bitstring a positive frequency deviation.

Ap2 Error Correction and Interleaving

Ap2.1 Error Correction

Error correction of data and voice packets shall be performed as follows:

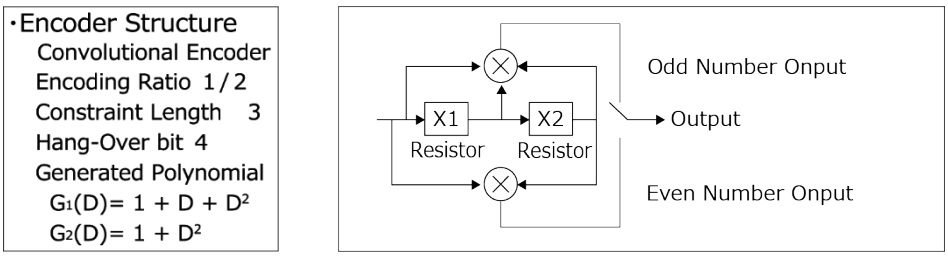
The error correction range shall be from flag 1 in the radio part header to P-FCS.

The error correction symbol shall be a convolutional symbol with a symbol factor of 1/2 and a constraint length of 3.

The value of the generated polynomial is 0x8408 (the LSB and MSB of 0x1021 are inverted).

Ap2.2 Interleaving

The interleaving shall be 24 bits.



Generation procedure

(1) Before encoding, set the convolutional encoder registers X1 and X2 to zero.

(2) Input the header information from LSB in 8-bit units to the coder.

(3) When all header information including "P_FCS" has been input, two bits of zero are input.

interleave structure MATRIX

(ms)		0.2	0.4	0.6	0.8	1	1.2	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	4	4.2	4.4	4.6	4.8	5	5.2	5.4	5.6	5.8
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
0.21	0	0	24	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480	504	528	552	576	600	624	648
6.03	1	1	25	49	73	97	121	145	169	193	217	241	265	289	313	337	361	385	409	433	457	481	505	529	553	577	601	625	649
12.1	2	2	26	50	74	98	122	146	170	194	218	242	266	290	314	338	362	386	410	434	458	482	506	530	554	578	602	626	650
18.1	3	3	27	51	75	99	123	147	171	195	219	243	267	291	315	339	363	387	411	435	459	483	507	531	555	579	603	627	651
24.1	4	4	28	52	76	100	124	148	172	196	220	244	268	292	316	340	364	388	412	436	460	484	508	532	556	580	604	628	652
30.2	5	5	29	53	77	101	125	149	173	197	221	245	269	293	317	341	365	389	413	437	461	485	509	533	557	581	605	629	653
36.2	6	6	30	54	78	102	126	150	174	198	222	246	270	294	318	342	366	390	414	438	462	486	510	534	558	582	606	630	654
42.2	7	7	31	55	79	103	127	151	175	199	223	247	271	295	319	343	367	391	415	439	463	487	511	535	559	583	607	631	655
48.3	8	8	32	56	80	104	128	152	176	200	224	248	272	296	320	344	368	392	416	440	464	488	512	536	560	584	608	632	656
54.3	9	9	33	57	81	105	129	153	177	201	225	249	273	297	321	345	369	393	417	441	465	489	513	537	561	585	609	633	657
60.3	10	10	34	58	82	106	130	154	178	202	226	250	274	298	322	346	370	394	418	442	466	490	514	538	562	586	610	634	658
66.4	11	11	35	59	83	107	131	155	179	203	227	251	275	299	323	347	371	395	419	443	467	491	515	539	563	587	611	635	659
72.4	12	12	36	60	84	108	132	156	180	204	228	252	276	300	324	348	372	396	420	444	468	492	516	540	564	588	612	636	
75.7	13	13	37	61	85	109	133	157	181	205	229	253	277	301	325	349	373	397	421	445	469	493	517	541	565	589	613	637	
81.5	14	14	38	62	86	110	134	158	182	206	230	254	278	302	326	350	374	398	422	446	470	494	518	542	566	590	614	638	
87.4	15	15	39	63	87	111	135	159	183	207	231	255	279	303	327	351	375	399	423	447	471	495	519	543	567	591	615	639	
93.2	16	16	40	64	88	112	136	160	184	208	232	256	280	304	328	352	376	400	424	448	472	496	520	544	568	592	616	640	
99	17	17	41	65	89	113	137	161	185	209	233	257	281	305	329	353	377	401	425	449	473	497	521	545	569	593	617	641	
105	18	18	42	66	90	114	138	162	186	210	234	258	282	306	330	354	378	402	426	450	474	498	522	546	570	594	618	642	
111	19	19	43	67	91	115	139	163	187	211	235	259	283	307	331	355	379	403	427	451	475	499	523	547	571	595	619	643	
116	20	20	44	68	92	116	140	164	188	212	236	260	284	308	332	356	380	404	428	452	476	500	524	548	572	596	620	644	
122	21	21	45	69	93	117	141	165	189	213	237	261	285	309	333	357	381	405	429	453	477	501	525	549	573	597	621	645	
128	22	22	46	70	94	118	142	166	190	214	238	262	286	310	334	358	382	406	430	454	478	502	526	550	574	598	622	646	
134	23	23	47	71	95	119	143	167	191	215	239	263	287	311	335	359	383	407	431	455	479	503	527	551	575	599	623	647	

Ap3 Symbols used in D-PRS

The symbol definition of APRS shall be prepared.

APRS Symbol Table (Rev.H)			ICOM ID-51A/E Icons and names	
Index	symbol	GPS xyz	Icon	Name
0	!	BB		Sheriff
6	,	BH		Small Aircraft
10	+	BL		Red Cross
12	-	BN		HouseQTH(VHF)
13	.	BO		X
14	/	BP		Red Dot
25	:	MR		Fire
26	;	MS		Campground
27	<	MT		Motorcycle
28	=	MU		Railroad Engine
29	>	MV		Car
34	C	PC		Canoe
36	E	PE		Eyeball
42	K	PK		School
43	L	PL		PC User
46	O	PO		Balloon
47	P	PP		Police
49	R	PR		Recreational
50	S	PS		Shuttle
51	T	PT		SSTV
52	U	PU		Bus
53	V	PV		ATV
54	W	PW		WX Service
55	X	PX		Helicopter
56	Y	PY		Yacht
58	[	HS		Person
59	\	HT		DF station
61	^	HV		Large Aircraft

APRS Symbol Table (Rev.H)			ICOM ID-51A/E Icons and names	
Index	symbol	GPS xyz	Icon	Name
63	`	HX		Dish Antenna
64	a	LA		Ambulance
65	b	LB		Bicycle
69	f	LF		Fire Truck
70	g	LG		Glider
71	h	LH		Hospital
73	j	LJ		Jeep
74	k	LK		Truck
77	n	LN		Node
79	p	LP		Rover
82	s	LS		Ship(powerboat)
84	u	LU		Truck(18-wheeler)
85	v	LV		Van
88	y	LY		Yagi @ QTH
12	-	ON		House (HF)
13	.	OO		Big Question Mark
15	0	A0		Circle
26	;	NS		Park/Picnic Area
29	>	MV		Overlayed Car
43	L	AL		Lighthouse
50	S	AS		Satellite
52	U	AU		Sunny
56	Y	AY		Radio
61	^	DV		Aircraft
66	C	SC		RACES
70	G	SG		Gale Flags
71	H	SH		Ham Store
73	J	SJ		Work Zone

APRS Symbol Table (Rev.H)			ICOM ID-51A/E Icons and names	
Index	symbol	GPS xyz	Icon	Name
76	M	SM		Speedpost
77	N	SN		Triangle
78	O	SO		Small Circle
82	S	SS		Overlayed Ship
83	T	ST		Tornado
84	U	LU		Overlayed Truck
85	V	LV		Overlayed Van
87	X	SX		Wreck

In the case of Alternate, it is possible to use an overlay by direct input. If you use the overlay on a symbol with the above icons, the text will be superimposed on the upper left corner of the icon, as shown below.

 Example: Overlay an "I" on a radio symbol (icom radio)

Refer these two URLs.

http://www.aprs.org/symbols/symbolsX.txt

http://www.aprs.org/symbols/symbols-new.txt

Ap4 Unprotocol addresses used in current models (as of January 31, 2019)

	Setting	Remarks
IC-2820	All Flags	Used with setting to "API282,DSTAR*" due to problems with D-PRS network
ID-92	API92,DSTAR*	
ID-80	API80,DSTAR*	
ID-880	API880,DSTAR*	
IC-9100	API910,DSTAR*	
ID-31	API31,DSTAR*	
ID-51	API51,DSTAR*	
IC-7100	API710,DSTAR*	
ID-5100	API510,DSTAR*	
ID-4100	API410,DSTAR*	
IC-9700	API970,DSTAR*	

Ap5 Domain name and port number of the current administration server

Domain name: trust.d-star.info
Rewrite/Inquiry port: 30001
Communication log forwarding port: 30000

Note: Starting from 6.0a, the access to the administration server has been changed to use the domain name.

* This information is applicable in Japan only, and has been kept to align with the original Japanese document.

Ap6 Allocated inquiry ID

0x0000 - 0x00FF	Reserved
0x0100	DV_AP
0x0101 -	Unallocated

Glossary

- Assist station

  Radio stations for relaying as defined in the examination standards related to the Radio Act (relay stations for trunk line communications)

- Trust Server

  This is the server that manages the Internet connection of the D-STAR system in Japan and its log, and is managed by the Japan Amateur Radio League.

- Gateway

  A device that connects a zone repeater station to the Internet (abbreviated as GW in this document).

- Zone

  A range or area where multiple repeater stations are connected by assist stations.

- Zone Repeater

  Repeater stations connected to the Internet within a single zone.

- Repeater area

  Area that can be covered by a single repeater station

- Repeater station

  A radio station that relays terminal stations (same as a conventional analog repeater)

- Repeater site

  Locations where assist stations, repeater stations, etc. are

Digital Smart Technologies for Amateur Radio (D-STAR)

(Digital Smart Technologies for Amateur Radio)

Version 4.3 released in September 2004

Version 4.3b released in December 2004

Version 4.3C released in March 2005

Version 5.0 released in August 2014

Version 5.0a released in September 2014

Version 5.0b released in October 2015

Version 5.0c released in February 2016

Version 6.0a released in January 2019

Issued by

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