



Recommendation ITU-R S.2062-0
(09/2014)

**Carrier identification system for
digital-modulation transmissions of
fixed-satellite service occasional use
carrier earth station transmissions
using geostationary-satellite
networks in the 4/6 GHz and
11-12/13/14 GHz FSS bands**

S Series
Fixed-satellite service

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Series	Title
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BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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RECOMMENDATION ITU-R S.2062-0*

Carrier identification system for digital-modulation transmissions of fixed-satellite service occasional use carrier earth station transmissions using geostationary-satellite networks in the 4/6 GHz and 11-12/13/14 GHz FSS bands

(Question ITU-R 271/4)

(2014)

Scope

This Recommendation provides possible methods about a carrier identification system for digital-modulations of fixed-satellite service (FSS) Occasional use (OU) carrier earth station transmissions from a fixed point to GSO space stations in the 4/6 GHz and 11-12/13/14 GHz FSS bands to facilitate the identification of the source of, and eliminate, unacceptable interference.

Keywords

Carrier-ID; occasional use; FSS.

Abbreviations/Glossary

ASCII	American Standard Code for Information Interchange
BCH	Bose, Ray-Chaudhuri, Hocquenghem code
BPSK	Binary phase shift keying
Carrier-ID	Carrier identification system
CRC	Cyclic redundancy check
FEC	Forward error correction
IRD	Integrated receiver/decoder
MPEG	Moving Picture Expert Group
NIT	Network information table
OU	Occasional use
PID	Packet identifier
PSD	Power spectral density
STB	Set top box
TDMA	Time division multiple access
TS	Transport stream

* Radiocommunication Study Group 4 made editorial amendments to this Recommendation in the year 2015 in accordance with Resolution ITU-R 1.

Related ITU Recommendation

Recommendation ITU-R S.2049 Access procedures for fixed-satellite service occasional use, transmissions to geostationary-satellite orbit space stations, in the 4/6 GHz and 11-12/13/14 GHz FSS bands

The ITU Radiocommunication Assembly,

considering

- a) that occasional use (OU) transmissions in the 4/6 GHz and 11-12/13/14 GHz FSS bands often require changes in earth station antenna pointing, frequency, power level, polarization sense, carrier bandwidth and modulation technique;
- b) that the wide use of OU transmitting earth stations, and their recurring changes in link parameters, has resulted in frequent cases of unintentional interference to other satellite users;
- c) that this interference is most frequently caused by operator error and/or equipment failure;
- d) that interference may inhibit the reception of time-sensitive information;
- e) that it is difficult to precisely identify the source of such interference;
- f) that there has been no internationally-recognized technical method for identifying the source of such interference;
- g) that technologies exist which will permit the identification of interference sources in a short period of time;
- h) that the ability to rapidly identify the source is essential to cease unacceptable interference,

recommends

1 that OU FSS earth station transmissions in the bands listed in *considering a)* could use a carrier identification system (Carrier-ID) to allow the timely detection of interference sources and to cease unacceptable interference;

2 that the carrier identification implementation described in Annex 1 should be considered in the implementation of *recommends 1*.

Annex 1

Methods to identify interference from fixed-satellite service occasional use earth station transmissions using geostationary-satellite networks in the 4/6 GHz and 11-12/13/14 GHz FSS bands

1 Introduction

In general, when interference is observed at a service provider's earth station, the provider tries to investigate the causes of interference by utilizing a spectrum analyser or similar measurement tools at each monitoring point for a certain period. Once the service provider finds a suspicious carrier, it consults with its satellite operator to assist with rectifying the problem. If the satellite operator cannot identify the possible source of interference, the resulting long-term interference may adversely

affect existing services. Therefore, a carrier identification system (Carrier-ID) would be beneficial in sparing existing services from long-term interference.

It is noted that Occasional use (OU) refers to satellite ground facilities and satellite transponder bandwidth, purchased or utilized on a temporary or as-needed basis. Typically these resources are offered in segments starting at 5 minutes, progressing up to multiple hours, days, weeks or even months, and used for non-fulltime and/or short-duration transmissions. Transmissions within a GSO FSS network where earth stations are under the automated control of a central station, such as transmissions within a centrally-managed VSAT network, are not considered OU transmissions for the purposes of this Recommendation.

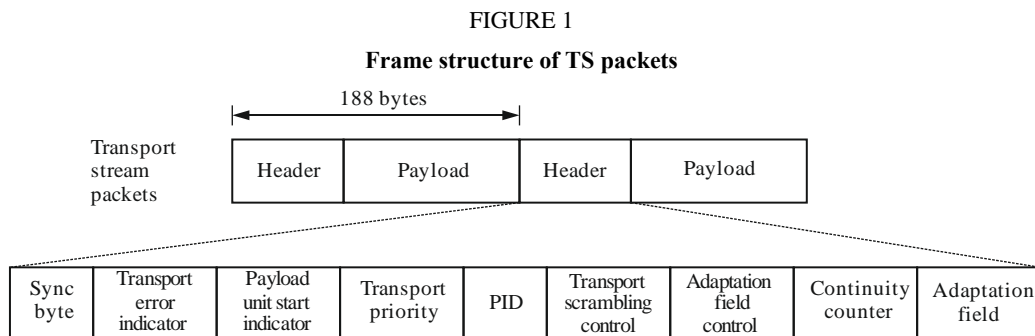
2 Overview of carrier identifier (Carrier-ID)

There are two methods of transmitting a Carrier-ID with the original carrier while having minimal impact on the desired data. Possible methods are as follows.

2.1 Method A: Network Information Table (NIT) Carrier-ID

- insert the Carrier-ID as a Network Information Table (NIT) frame in the original Transport stream (TS) packets of the MPEG Stream.

TS packets of MPEG streams consist of a 4 bytes header and 184 bytes payload, and in the header, there is a Packet identifier (PID) which indicates the contents in the payload of TS packets defined as in Fig. 1. This PID value needs to be set as 0x0010 to indicate a payload of a TS packet as a NIT. With regard to the NIT itself, the DVB specification allows this table to be retransmitted between 25 ms and 10 s.



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In the payload of TS packets, the NIT contains the manufacturer’s name and the unique unit serial number to provide unique identifier for traceability. In addition to that, any other optional data such as phone number, location information, etc. shown in Table 1, could be included in the payload of TS packets depending on the requests from the satellite operators. These strings are fixed length, and shall be separated by a comma ‘,’. If there are padding characters in each of strings, an underscore “_” will be used to make complete the string. With these rules, total character counts for Carrier ID in the NIT frame shall be 80. When the TS packets containing NIT are suffering from interference or if the TS packets are encrypted, the NIT is unable to be read by a decoder.

Some manufacturers of encoders enable NIT Carrier-ID in equipment already available or through a firmware update.

TABLE 1

An example content ID and content information

Carrier identifier format	2 character string numeric only
Encoder manufacturer	5 character string
Encoder serial number	12 character string
Carrier identifier	5 character string
Telephone number	17 character string numeric only
Longitude	9 character string
Latitude	8 character string
User information	15 character string

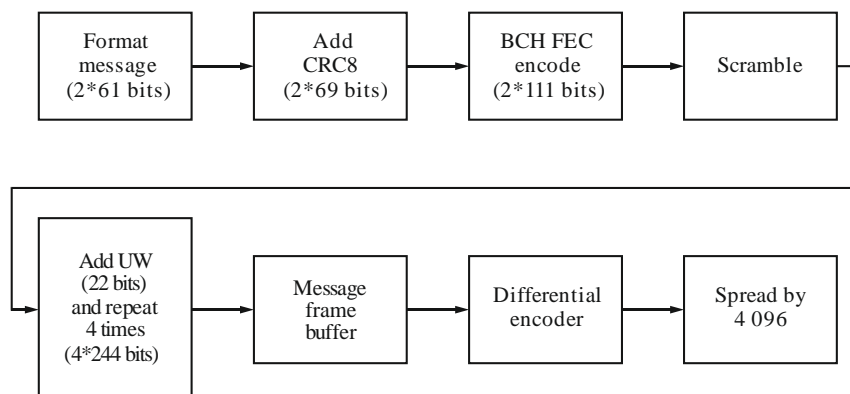
2.2 Method B: Spread Spectrum Carrier-ID

- Carrier-ID with specific carrier information is embedded within a low rate spread spectrum carrier which is sent overlaying the original carrier without adding appreciable noise to the original carrier.

By contrast to the NIT method, in the Spread Spectrum method, the Carrier-ID information is more likely to be successfully extracted even in the presence of severe interference. Spread Spectrum Carrier-ID is available on existing modulators from some manufactures and is available as a firmware update on a few not-too-old modulators. Modulators with Spread Spectrum Carrier-ID are marked with a DVB-CID symbol. An external Carrier-ID encoder can also be purchased to add Carrier-ID to existing modulated carriers. Dedicated equipment is needed to detect and decode the Spread Spectrum Carrier-ID on the receiving side.

Figure 2 shows an example Carrier-ID spread block diagram. After the Format Message is set completely, this message is encoded by the CRC encoder, and also encoded by the BCH FEC encoder, and then a Carrier-ID frame is constructed with adding the unique word bits. This Carrier-ID will be scrambled and spread using the 4 096 chips/bit afterward.

FIGURE 2

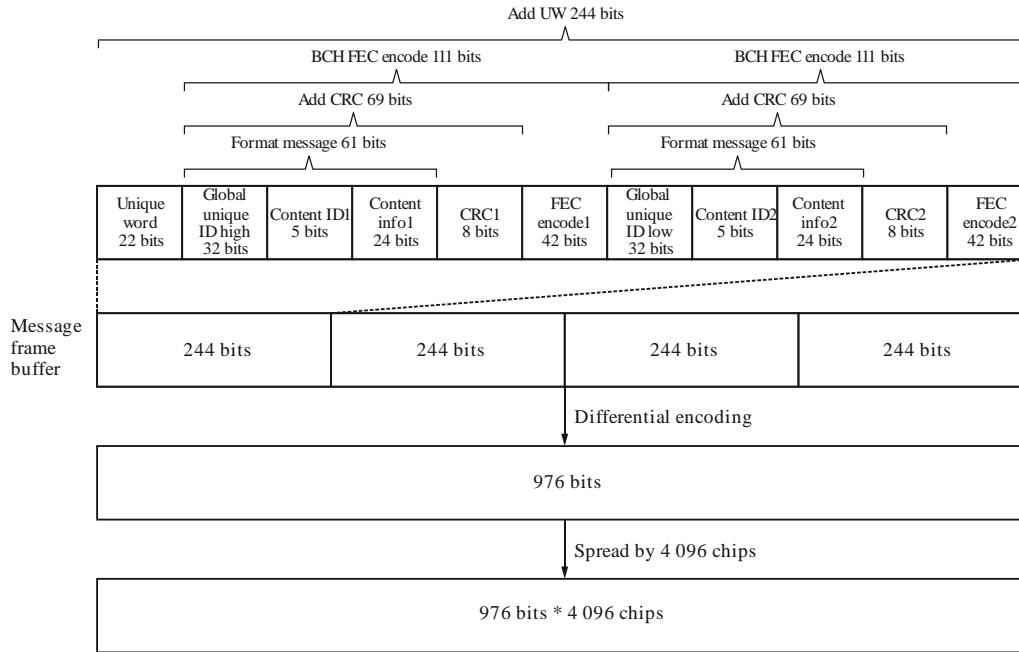
An example Carrier-ID spread block diagram

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Following this Carrier-ID spread block diagram, the Carrier-ID Frame is spread as indicated in Fig. 3. At first, a Format Message is created by operators via the front panel or remote user interface, and this message includes a “Global Unique ID_High and Low” identifier, Content ID and Content

Information. As for Global Unique IDs, Global Unique ID_High indicates Manufacture ID, and Global Unique ID_Low indicates Extended ID.

FIGURE 3
An example scheme of the Carrier-ID frame



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Table 2 shows example Content ID and Content information which help to identify the location of the carrier source. Operators should enter the information of the source into each of information field, as required by their satellite operator.

TABLE 2

Example content ID and content information

Content ID	Information field content
0	Carrier ID revision code
1	Latitude
2	Longitude
3-5	Telephone No.
6-12	User Data (Message by ASCII code)
13-31	Undefined

After spreading, each chip of the sequence of the Carrier-ID frame shall be mapped into a BPSK constellation to generate a modulation symbol. This BPSK mapping signal shall be transmitted with lower power spectral density (PSD) than the noise floor of the original carrier by adjusting the transmitting gain not to affect the throughput over the satellite.

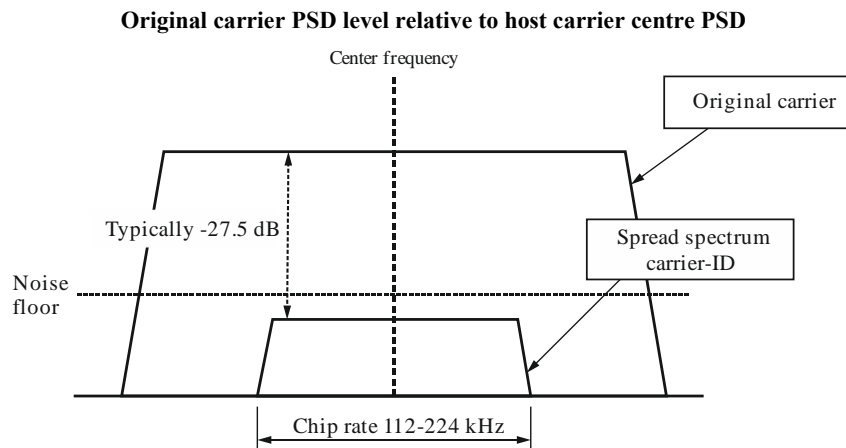
Therefore, Table 3 and Fig. 4 show the example definition of the relative power spectral density against the original carrier in detail.

TABLE 3

Example relative power spectral density levels for the original carrier

Carrier-ID's chip rate (kHz)	Host carrier symbol rates (S) range (kBaud)	Original carrier PSD level relative to host carrier centre PSD (dB)
112	$128 \leq S < 256$	-27.5
112	$256 \leq S < 512$	-27.5
224	$512 \leq S < 1024$	-27.5
224	$1\ 024 \leq S < 2\ 048$	-27.5
224	$2\ 048 \leq S < 4\ 096$	-24.5
224	$4\ 096 \leq S < 8\ 192$	-21.5
224	$8\ 192 \leq S < 16\ 384$	-18.5
224	$16\ 384 \leq S$	-17.5

FIGURE 4



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2.3 Comparative specifications between NIT Carrier-ID and Spread Spectrum Carrier-ID

Table 4 shows the comparative specification between NIT Carrier-ID and Spread Spectrum Carrier-ID systems with advantages and disadvantages of each system.

TABLE 4
Comparative specifications

	NIT Carrier-ID	Spread Spectrum Carrier-ID
Transponder and Carrier Compatibility	Requires MPEG-TS (Video) <ul style="list-style-type: none"> – Broadcast Contribution – Broadcast Distribution 	Agnostic to traffic carrier or transport mechanism <ul style="list-style-type: none"> – Video and Data transport focused
Changes to original carrier	Yes (add NIT table)	No (spread spectrum carrier is overlay to the original carrier)
Robustness	Low (Carrier-ID not recoverable if the original carrier is down)	Higher (Carrier-ID can be decoded even if the original carrier is down)
Injection point	Modulator or Encoder	Modulator
Carrier ID decode speed	Under 10 seconds	15 seconds to over 1 minute*
Ease of deployment	Modulator: Software upgrade only Decoder: existing IRD and STB	Modulator: DVB-CID Compliant Modulators or additional dedicated equipment Decoder: additional dedicated equipment

* Decoding speed of the Spread Spectrum Carrier-ID depends on the relative power of the interfering carrier and the desired carrier, the accuracy of the estimate of the symbol rate of the interfering carrier, and the accuracy of the estimate of the centre frequency of the interfering carrier.

3 Carrier-ID identifying configuration

As mentioned above, in general, NIT does not need special equipment to insert and detect the Carrier-ID, i.e. just updating the software of the modulator or encoder, while the Spread Spectrum method requires dedicated equipment to insert the Carrier-ID for older modulators that are not DVB-CID compliant.

The receiving devices also need special function of receiving and identifying or decoding the Carrier-ID. However, the function of decoding the ID need not to be installed in all receivers, but a dedicated receiver, which may be owned and operated by the satellite operator.

The satellite operator also needs to control and maintain the Carrier-ID in an integrated fashion, i.e. their customer database, in order to resolve an ID to a transmitting earth station.

4 Summary

Carrier-ID may be used to facilitate the rapid identification of an interference source and reduce the time required to clear the interference that occurs unintentionally.