

Recommendation 21-2R2

**EFFICIENT SPECTRUM UTILISATION FOR SPACE SCIENCE SERVICES ON  
SPACE-TO-EARTH LINKS; CATEGORY A**

The SFCG,

CONSIDERING

- a) that frequency bands allocated to the space science services are becoming more congested as space missions multiply, data rates increase and other services enter these bands;
- b) that usage of spectrum beyond what is actually required increases the potential for interference to other users and at the same time may result in a higher susceptibility to interference from other users of the band;
- c) that notified bandwidth requirements beyond the amount of spectrum actually required generally increases the coordination burden;
- d) that the use of PCM/PM/Bi-phase or PCM/PM/NRZ modulation is only justified when a distinct carrier component is required and for symbol rates below 2 Ms/s<sup>1</sup>;
- e) that in some exceptional cases, such as data relay satellite inter-orbit links, PFD limits laid down in ITU/RR S 21.16 cannot be met with efficient modulation schemes;
- f) that some frequency bands of the space science services are allocated with a secondary status resulting in very difficult sharing conditions, which may require the use of spread spectrum-type modulations;
- g) that filtered modulation schemes have bandwidth characteristics which generally reduce coordination burdens and that spectrum shaping can be used to significantly reduce the occupied bandwidth;
- h) that the use of sub-carriers shall be limited, as stipulated by SFCG REC 21-3;
- i) that trellis-coded modulators act as an encoder and a modulator<sup>2</sup>.

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<sup>1</sup> For non spectrum modifying modulation, the symbol rate is defined as the baseband single line bit rate at the input of the RF modulator. See figure 2.

<sup>2</sup> For trellis-coded modulation, the symbol rate is defined as the baseband single bit rate at the input of an equivalent modulator. See figure 3

## RECOMMENDS

1. that, with immediate applicability to all space science service bands, space agencies use the most bandwidth efficient modulation schemes practicable for their missions;
2. that, with immediate applicability to all space science service bands, PCM/PM/Bi-phase or PCM/PM/NRZ modulation shall only be used when a carrier component is technically necessary and for symbol rates below 2 Ms/s.
3. that the emitted spectrum<sup>3</sup> for all Space Science Services projects starting in/or after the year 2001 and that will utilize space-to-Earth link frequency assignments in the bands 2200–2290 MHz, 8025–8400 MHz and 8450–8500 MHz, adhere to the spectral emission masks in figure 1.

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<sup>3</sup> Measured relative to the peak of the telemetry spectrum and excluding all spurious emissions.

Figure 1: Spectral Emission Masks

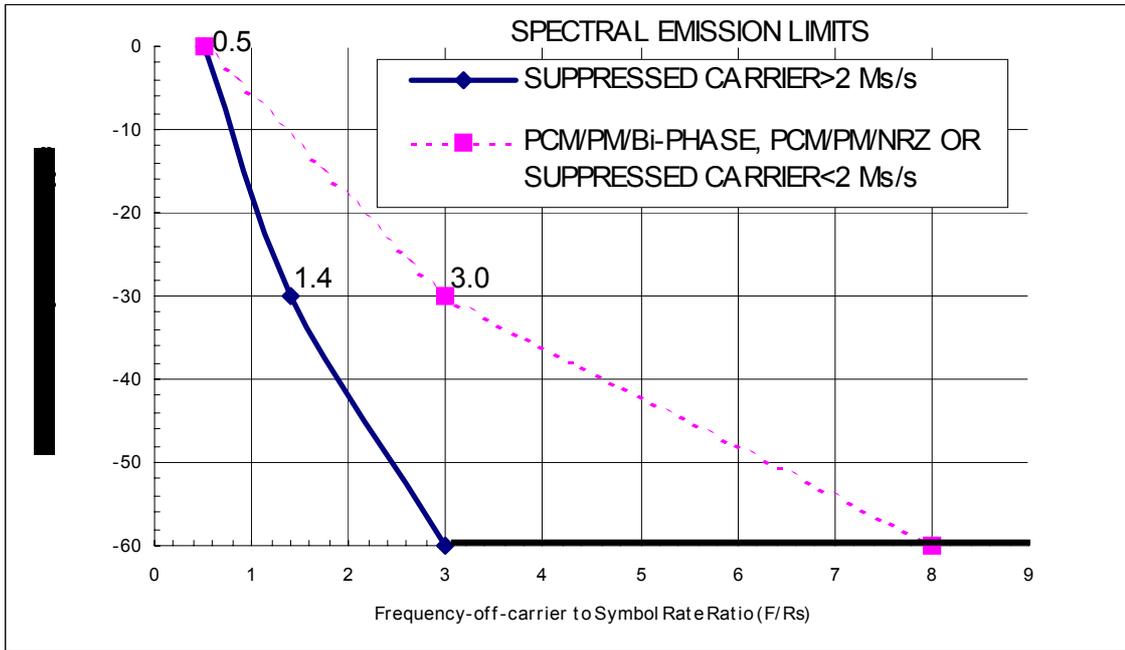


Figure 2: Non Spectrum Modifying Modulation Definitions

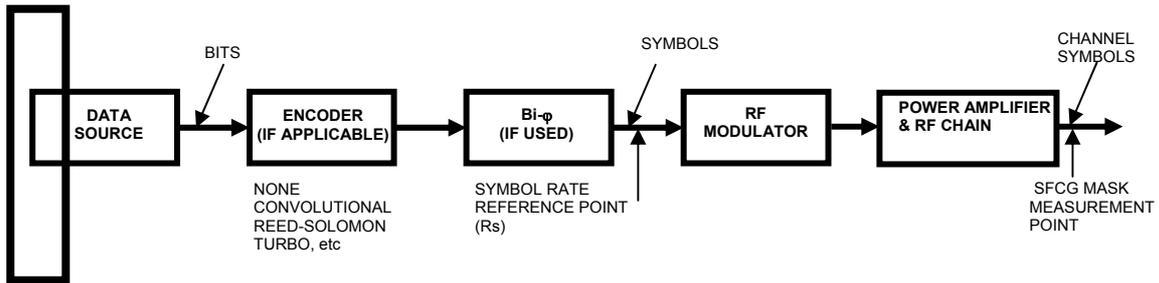


Figure 3: Trellis-Coded Modulation Definitions

