



CCSDS

The Consultative Committee for Space Data Systems

**Draft Recommendation for
Space Data System Standards**

**PSEUDO-NOISE (PN)
RANGING SYSTEMS**

DRAFT RECOMMENDED STANDARD

CCSDS 414.1-P-2.1

PINK SHEETS

August 2021

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PREFACE

This document is a draft CCSDS Recommended Standard. Its ‘Pink Sheet’ status indicates that the CCSDS believes the document to be technically mature and has released it for formal review by appropriate technical organizations. As such, its technical contents are not stable, and several iterations of it may occur in response to comments received during the review process.

Implementers are cautioned **not** to fabricate any final equipment in accordance with this document’s technical content.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

3.3.2.2 Modulation Scheme

The ranging signal shall be linearly phase modulated on the uplink carrier; i.e., a positive transition of -1 to $+1$ in the base-band code shall result in an advance of the transmitted RF carrier phase.

3.3.2.3 Base-Band Shaping

Base-band shaping should be used on the PN ranging signal to conserve bandwidth at high chip rates and high modulation indexes.²

3.3.2.4 Base-Band Shaping Filter Impulse Response

The shaping filter shall have the following impulse response:

$$h(t) = h_{\sin}(t) = \begin{cases} \sin(\pi t / T_c) & t \in [0, T_c] \\ 0 & \text{elsewhere} \end{cases}$$

where T_c is the chip duration.

3.3.2.5 Ranging and Telecommand

Ranging according to this standard and telecommand as specified in CCSDS 401.0-B 2.2.4 and 2.2.7 (reference [1]) may be performed at the same time.

3.3.3 UPLINK CHIP RATE

The ranging signal chip rate shall be frequency coherent with the uplink carrier as given by the following expression (for $k=6$ and $l=\{1,2,\dots,12,16,32, \text{ or } 64, \text{ or } 94\}$ or for $l=2$ and $k=\{8,9, \text{ or } 10\}$). The value $l=94$ shall only be used for Ka-band³ uplinks. See also an example of available chip rates in annex B.

² Reference [C1] may be consulted for the analysis of occupied bandwidth versus modulation index.

³ 34200–34700 MHz.