

DEFINITION FOR PING AND BURST FOR SCIENTIFIC ANALYSIS OF AMATEUR RADIO METEOR SCATTER

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For the analysis of scientific data the old way of defining a ping and a burst, which depended on information / no information, is not relevant.

Therefore for the correct analysis the following definitions should be used:

Ping: Reflection from an underdense meteor trail.
Burst: Reflection from an overdense meteor trail.

Background:

Radio Amateurs have used the term "ping" to describe a "short" reflection. Most of the European operators define "ping" as a reflection too short to pass information. This definition was most likely evolved in the 1970's, when high speed CW (then < 600 LPM) gained popularity in Europe. With the less efficient equipment used those days, the shorter reflections were either too short to pass full characters due to slow speed and/or too weak to decode with the equipment available at that time.

Some operators define "ping" as a reflection from an underdense meteor trail and "burst" as a reflection from an overdense trail. This is also how "ping" and "burst" are described in The VHF/UHF DX Book (published by RSGB). Generally it can be said that most good reflections come from overdense trails and short/less usable reflections (pings) from underdense trails. Overdense and underdense reflections can be roughly separated by duration of the reflection (reference 1).

The principal difference of underdense and overdense trail is the mechanism that re-emits RF-energy. On underdense trails the RF-energy penetrates the trail and makes electrons oscillate and re-radiate energy, while on overdense trails, no penetration occurs and the trail is modeled as a metallic cylinder reflecting RF-energy. When receiving meteor reflections the audible differences are found in signal strength, duration and decaying shape.

CW speeds used in MS have increased since 1970's by about four times and new digital equipment (i.e. DTR) make copying useful information from a weak reflection now much more easier. The old way of defining a ping has thus become invalid and does have serious lack of logic by definition, while the underdense/overdense division is based on well known and studied physical facts, as described in scientific literature.

It would also be extremely useful, if MS working results published i.e. in DUBUS were of scientific use. Such working results could be used by people like OH5IY, who are doing scientific research on meteor scatter. QSO information in DUBUS contain the number of pings and bursts of every contact. This information is of little use, however, if ping is understood as a reflection with no information, thus depending on speed used. Instead, if ping is defined as an underdense reflection this kind of information would be of great value. The relative number of underdense and overdense reflections could be compared between different showers and between consecutive hours in the same shower. This would provide us new knowledge of meteor showers and sporadic meteors.

Aid for defining underdense and overdense trails:

Underdense and overdense reflections can be roughly separated by duration of the reflection (which varies by frequency). The threshold is not sharp, but a simple approximation can be made. On 50 MHz overdense trail durations are typically greater than 0.5 s (reference 1) and maximum underdense trail durations approximately 0.5-1 s (reference 2).

In the following table a 1 s reflection on 50 MHz has been taken as upper limit for the underdense trails. Durations for other frequencies have been derived from it according to following formula (reference 3):

$$t \hat{=} \frac{\sqrt{300\bar{D}}}{\bar{U}_f \bar{L}} / 36$$

where t = duration in seconds,
 f = frequency in MHz

Maximum duration of an underdense reflection (ping):

Frequency	Duration	CW speed	Number of letters received
50 MHz	1 s	100 LPM	2
		1000 LPM	17
		2000 LPM	33
70 MHz	0.5 s	100 LPM	1
		1000 LPM	8
		2000 LPM	17
145 MHz	0.1 s	100 LPM	0
		1000 LPM	2
		2000 LPM	4
435 MHz	0.013 s	100 LPM	0
		1000 LPM	0
		2000 LPM	0

This table corresponds well with the situation as presently encountered on the popular 144 MHz band. For example, a reflection on 145 MHz with the speed of 1000 LPM containing up to two letters when decoded would be a ping. On the 435 MHz band pings are so short in duration (less than 0.013s) as to be almost impossible to detect.

References:

1. The evolution of meteor burst communications system, P.S. Cannon & A.P.C Reed, Journal of the Institution of Electronic and Radio Engineers, Vol. 57. No. 3, pp 101-112, May/June 1987.
2. J.A.Weitzen & al., An Estimate of the Capacity of the Meteor Burst Channel, IEEE Transactions on Communications, Vol.Com-32, No.8. August 1984.
3. W.T. Ralston & al. Distribution of underdense meteor trail durations and duty cycle and applications to meteor scatter communication system design. Radio Science, Volume 28, Number 5, pp 747-757, September-October 1993