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THE SAN MARINO SCALE: A NEW ANALYTICAL TOOL FOR ASSESSING TRANSMISSION RISK

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ABSTRACT

Nearly everyone is familiar with the Richter Scale for quantifying earthquake severity. Can we similarly quantify the potential hazard of active SETI -- that is, transmitting signals into space from Earth? The San Marino Scale is an attempt to do just that. It is an ordinal scale between one and ten, used to quantify the potential risk of employing electromagnetic communications technology to announce Earth's presence to our cosmic companions, or to reply to a successful SETI detection. In this paper we present the rationale behind the San Marino Scale, its history, precedents, structure, regulatory implications, and potential applications in assessing the probable impact of an admittedly controversial activity.

INTRODUCTION

While SETI, the Search for Extra-Terrestrial Intelligence, is a widely accepted science, the reciprocal activity sometimes called METI, Messaging to Extra-Terrestrial Intelligence, remains a controversial area, and receives much discussion and debate within the SETI community. It has been argued that a civilization which hopes to detect radio evidence of other civilizations in the cosmos is obligated to reveal its own presence. Others maintain that it is suicidal to shout in the jungle. Heretofore, there has been no analytical tool to quantify the impact of transmissions from Earth. The authors of the San Marino Scale seek to change that. While not particularly endorsing either side of the transmission debate, we propose a tool to give such discussions a modest analytical basis.

HISTORY

This metric for quantifying transmission risk was first proposed in the Republic of San Marino (hence its name) by Iván Almár in a paper presented to the 6th World Symposium on the Exploration of Space and Life in the Universe, in March, 2005. Under Prof. Almár's leadership, members of the IAA SETI Permanent Study Group are being asked to continue working to refine and perfect it, in order to bring some objectivity to the otherwise subjective interpretation of interstellar transmission risk.

PRECEDENTS

In many ways, it has been suggested, the consequences of transmitting signals from Earth into space could be similar to the approach toward Earth of a large asteroid. Published in 1997, the so-called Torino Scale quantifies the significance of such a potential threat. The two-dimensional Torino Scale takes into account both the potential damage from such an asteroid impact, and the probability that it will collide with Earth.

The Rio Scale adopted by the IAA SETI Permanent Study Group in 2003 borrows heavily on the design of the Torino Scale. It attempts to quantify the relative importance of a rare event (in that case the detection of a candidate SETI signal) in terms of both its potential societal impact and the credibility of the evidence presented.

Similar to both of these indices, the San Marino scale is intended to quantify the potential hazard not from reception (of either asteroid impact or incoming electromagnetic signals), but rather the transmission from Earth of messages into space. It uses mathematics similar to its predecessors, the Torino and Rio scales, to permit alternative transmission scenarios to be evaluated, contrasted, and compared.

Because laymen and professionals alike are accustomed to assessing a wide variety of qualitative parameters on an ordinal scale extending from one to ten, that is the numerical range assigned to candidate transmissions by the San Marino Scale. Values are obtained by considering both the intensity (or radiated power in a given direction) of a candidate transmission, and its inherent nature, information content, and duration.

Interpretation of the San Marino Index, an integer value which the proposed Scale purports to compute, is depicted graphically in Figure 1.

Figure 1
Graphical depiction for
San Marino Scale interpretation

STRUCTURE

As originally proposed, the San Marino Index is mathematically defined as:

SMI = I + C [Equation 1]

where **SMI** is the numeric San Marino Index, on an integer scale of 1 to 10,

I is a logarithmic measure to the base 10 of signal strength or intensity, relative to the Earth's background radiation intensity (think "Bels over background"), with a maximum value of 5,

and **C** represents the characteristics of the transmission, with regard to information content, intentions, direction, and duration.

Table 1 shows the relationship between transmission intensity and the associated integer value for purposes of computing the San Marino Index. The classes of transmission being considered for inclusion in determining the San Marino Index, and the integer values associated with each, appear in Table 2.

Intensity of Transmission	Value of I
≥ 100,000 * Io	5
~ 10,000 * Io	4
~ 1,000 * Io	3
~ 100 * Io	2
~ 10 * Io	1
Current average level of the terrestrial noise background intensity in the frequency band of the transmission (~Io)	0

Table 1
Determination of the I term

Character of Transmission	Value of C
Reply to an extraterrestrial signal or message (if they are not yet aware of us!)	5
Continuous, omnidirectional, broadband transmission of a message to ETI	4
Special signal in a preselected direction at a preselected time in order to draw attention of ET astronomers	3
Message with the intention to reach ETI -- an arbitrary direction for minutes, hours (e.g., Evpatoria)	2
A beacon without any message (e.g., planetary radar)	1

Table 2
Determination of the C term

It should be noted that the San Marino Scale is a tool for dynamic, rather than static, analysis. Throughout the life of any transmission program, as power levels and transmission characteristics change, the event's potential hazard will change. Thus, the San Marino Scale value assigned to any active SETI experiment or other transmission from Earth can be expected to change significantly (either upward or downward) over time.

REGULATORY IMPLICATIONS

The SETI community has for years been engaged in ongoing policy and protocol discussions, dealing with the possibility or advisability of issuing either binding or voluntary restrictions or prohibitions against deliberate transmissions from Earth. The proponents of the San Marino Scale recognize that not all such transmissions imply the same level of risk or hazard. We hope that the international SETI community will consider using this tool for helping to define a threshold, below which no prior consultation may be required in the event of a transmission from Earth, but above which discussions should take place, and a consensus be sought, prior to engaging in active SETI or replying to received signals.

SAN MARINO CALCULATOR

To allow participation by the broadest cross-section of the SETI community in optimizing and evaluating this proposed analytical tool, the authors have placed an interactive San Marino Scale Calculator on the website of the IAA SETI Permanent Study Group. This calculator can be located by browsing to <http://iaaseti.org>, clicking on either Protocols or Rio Scale from the Main Menu at left, and then following the links. Alternatively, the calculator may be accessed directly, using this link:
http://www.setileague.org/iaaseti/smicalc.htm

The structure of the JavaScript calculator makes its use quite intuitive. Radio buttons enable the user to quickly enter the particulars of any transmission (hypothetical or actual) being analyzed. The calculator software then computes the resulting San Marino Scale value for the event under study. We invite members of the scientific community and the press to use this tool for estimating San Marino index values during analysis of candidate transmissions from Earth, and to assign San Marino Scale values in quantifying their estimates of the potential hazard associated with any active SETI project.

Webmaster's Disclaimer: The San Marino Scale Calculator on the IAA SETI Permanent Study Group website requires a JavaScript-enabled browser. Your browser must be set to "allow active content." Some browser security settings block active content, and thus will inhibit this calculator's performance.

GENERAL DISCLAIMER

The San Marino Scale is neither an adopted standard nor a firm proposal, but merely a suggestion thrown out for consideration and refinement by the SETI community. Information presented in this paper is intended to be used by members of the IAA SETI Permanent Study Group for purposes of discussion, criticism, refinement, and possible further development (or even rejection) of this research tool. The San Marino Scale is very much a work in progress; users should expect that the San Marino

Scale page on the IAA SETI Permanent Study Group website, and the San Marino Scale Calculator located there, will change from time to time. The current version described herein, Revision 0.1, has yet to be officially accepted or endorsed by the IAA SETI Permanent Study Group, or any other body.

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