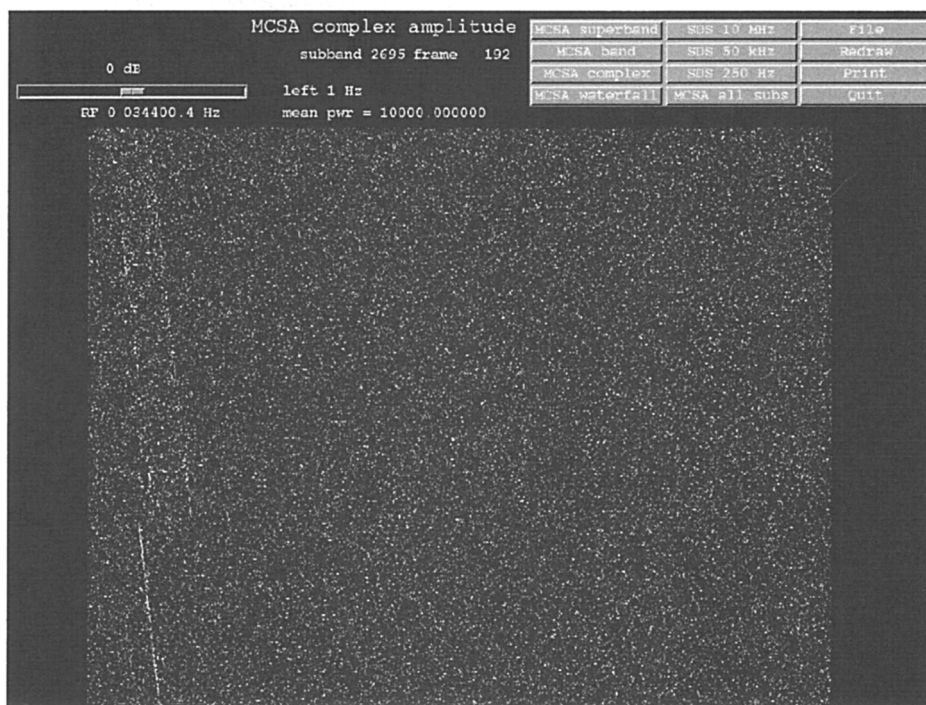


# POST SETI



Waterfall plot from Pioneer signal (*photo: SETI Institute*)



Ray & Cilla Norris (*photo: Seth Shostak*)

## How to Respond to a SETI Detection

Ray P. Norris

*CSIRO Australia Telescope National Facility, PO Box 76, Epping, NSW  
1710, Australia*

**Abstract.** Implicit in the significant resources invested globally in SETI searches is the assumption that there is a small but finite probability that one such search will be successful in the next few years. The potential significance of such an event makes it essential to have contingency plans in place to deal with it. I describe the processes that are in place to deal with a SETI detection, including the SETI Post-Detection Committee and outline the challenges facing us.

### 1. Introduction

Several SETI searches are being conducted worldwide, using a variety of techniques and wavelengths (e.g., Tarter 2004). We do not know, of course, what the probability of a detection is, but, unless such searches are a completely wasted effort, there is some finite but very uncertain a priori likelihood that one such search will be successful, or will appear to be successful, in the next few years. In the event of a putative detection, there would be intense media interest, and a variety of intense pressures placed on those scientists and engineers involved, which would make it difficult to conduct a thoughtful, rational, decision process as to the best way in which to respond. It is therefore essential that contingency plans are constructed in advance. The purpose of this paper is to alert groups that such plans exist and are encapsulated in the SETI Post-Detection Committee (PDC), the members of which are available for consultation in the event of a putative detection.

Rather than describe plans in detail, in this paper I illustrate the various issues by stepping through a hypothetical scenario of a SETI detection.

### 2. Before the Detection

A guide as to the initial steps to be taken may be found in the "Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence", (Billingham et al. 1996). This declaration, which is widely referred to as "the SETI Protocol", details the actions to be taken in the event of a putative SETI detection. The Protocol can be found on:

<http://www.seti-inst.edu/science/principles.html>

and, while having no legal force, has been adopted by nearly all SETI researchers.

The last clause of this protocol describes the formation by the International Academy of Astronautics (IAA) of a body of experts drawn from different fields to be available to give expert advice in the event of a detection. That clause was implemented by the IAA by forming “The SETI Post-Detection Committee” (PDC) which was set up to “advise and consult on questions stemming from the discovery of a putative signal of extraterrestrial origin”. Formally, the PDC is a sub-committee of the SETI Committee of the IAA.

The broad role of the PDC breaks down into four distinct tasks:

- **Preparation:** Preparing for a SETI detection, thinking through the issues.
- **Confirmation:** In the event of a detection, helping determine how credible the detection is, or helping detect a hoax or spurious detection
- **Analysis:** In the event of a detection, coordinating follow-up observations and analysis by various groups
- **Public communication:** In the event of a detection, giving expert advice to media and other stakeholders

The PDC consists of experts from a number of different fields (astronomy, engineering, signal processing, computer science, biology, sociology, etc.) who have already spent some time thinking through the issues involved. A list of its members may be found on <http://atnf.csiro.au/people/rnorris/SETI>.

### 3. The Putative Detection

In this hypothetical scenario, I assume that a major radio observatory has detected what appears to be a SETI signal, either as part of a SETI search or serendipitously in the course of making other astronomical observations.

If the observatory follows the SETI protocol, staff at the observatory will make as many checks as possible using their own system. For example, they should check that the signal disappears when the telescope is moved a small number of beamwidths off source, and re-appears when the telescope goes back on source. They should check that the signal moves as expected in frequency when the local oscillator is changed, and that making other changes to the receiver system (e.g., changing polarisation) makes the signal behave like a genuine extraterrestrial signal rather than interference. They should also check the security logs of the observatory computers to check whether their firewall has been breached by a hacker or hoaxer.

If the signal passes these tests, then another radio observatory should be contacted and asked to check on the signal. According to the SETI Protocol, this should be done before any public announcement is made, to prevent false alarms and embarrassment, but experience suggests that in practice any apparent detection that survives these preliminary tests is likely to be leaked to the media at an early stage (Shostak 2004).

Even if it has not already been leaked to the media, now is the time to alert groups such as SETI groups and the SETI Post-Detection Committee. The advantage of involving these groups at an early stage is that there will be individuals who have already thought through and discussed many of the issues,

and so will be in a better position to give advice than an observer meeting these issues for the first time.

Asking another observatory to check the signal has a number of advantages, as the other observatory is likely to be geographically distant, and thus not subject to the same sources of interference, is likely to have different software and hardware, and thus not prone to the same bugs, and is unlikely to have been hacked by a hoaxer in an identical way. Involving another observatory also has the advantage of spreading knowledge of the detection into a broader domain within the research community. If a VLBI (very long baseline interferometer) experiment can be set up between the two telescopes, it is possible to check whether the source is in the near field (e.g., a satellite or solar-system spacecraft) or whether it is far-field (i.e., outside the solar system).

If the detection passes this test, then it can reasonably be claimed as a “putative detection”, and at this stage the situation will escalate significantly. No apparent SETI detection to date has survived up to this point.

#### 4. Immediate Post-Detection

If the signal is confirmed by another observatory, then it is a genuine SETI detection, a previously unknown type of natural phenomenon, a very clever hoax, or an extremely subtle form of interference or instrumental bug. None of these can be discounted at this stage.

A series of hoaxes and errors have taught the SETI community how the media respond to a claimed SETI detection. In the absence of correct information, spurious information appears, and so it is important to brief the media and other stakeholders with expert, authoritative, information. The SETI protocol lists the steps that should be taken to disseminate information about the putative detection, including:

- Inform the governments of all countries involved
- Inform all astronomers using the IAU telegram system
- Hold simultaneous press conferences in all countries that are now involved
- Inform the various scientific bodies listed in the “SETI Protocol”

A particular problem is how to convey to the media and public the level of credibility of a putative detection. It is very unlikely that a putative detection can quickly be established as a genuine SETI detection with 100% reliability, and so some means of conveying this uncertainty is needed. Almar & Tarter (2001) have proposed a scale called the “Rio Scale”, which is similar in concept to the Torino scale for potential asteroid impacts, and ranks the perceived significance of a potential SETI detection. A zero on the Rio Scale indicates that the detection is a hoax or an error, while a ten on the Rio scale indicates certainty that the detection is a genuine communication from another civilisation. Most putative detections will start with a low value on the Rio scale, and then either decrease or increase as the confirmation process proceeds.

It is likely that public and media interest will be so high that web sites and email facilities of prominent radio observatories and SETI groups, including

the PDC, will be rendered inoperable by the large volume of requests. Thus, so that the PDC can continue to function effectively at its most critical time, it is essential that groups such as the PDC set up a private web site and email facilities on a server unconnected to SETI or to astronomy.

It is occasionally suggested that the announcement of a credible SETI detection might result in public panic. However, a small number of clever hoaxes have taken place over the last few years, each of which was near-credible for hours to days before being debunked. In each of these cases, there was no reported sign of any panic behaviour, suggesting that public panic is unlikely to occur in the case of a genuine detection. However, to avoid any such panic it will be essential that media are supplied with accurate, authoritative, information, and that the media behave responsibly in their reporting, avoiding sensationalism that might link a SETI detection to a "War of the Worlds" scenario.

As the SETI detection gains credibility, it is possible that government agencies will not be willing to entrust an event of such significance to academic researchers, and so it would be unrealistic for the PDC or any other SETI group to assume that it can retain control of the process. In this case, to avoid ill-informed responses, it will be important for government agencies to have access to expert advice. The best role for the PDC in that case is to act in an expert advisory capacity to the relevant government agencies.

## 5. Post-confirmation

Once it has been established beyond reasonable doubt that the signal is a communication from another civilisation, there is a temptation to reply immediately. The SETI protocol states unambiguously that this should not be attempted. This is because:

- Our first message to another civilisation should be a considered message on behalf of all of humanity, as represented by a responsible group such as the United Nations (I ignore TV and radar transmissions which leak from the Earth, as their range is several orders of magnitude less than a directed transmission through a high-gain antenna). No process yet exists to construct such a message, and nor would it be appropriate since:
- The civilisation is likely to be many light-years distant, and so their message has taken many years to reach us. Our response, if any, will take many years to reach them, and so there is no hurry to construct a message. Instead, we should take years to construct a carefully-crafted response.
- There is a view held by some individuals within the SETI community that transmitting a message necessarily involves exposing humankind to a small but finite risk (e.g., Ryle 1974). These individuals feel that the decision to expose humankind to such a risk should not be taken arbitrarily by a small group of scientists, but should only be taken (if at all) by some responsible group such as the United Nations.

Nevertheless, it is likely that small but well-funded groups will attempt to send their own messages, perhaps representing the views of one particular

faction (e.g., a religious cult). It would then be ludicrous to send subsequent “official” messages explaining to the aliens that those first messages were not representative (e.g., “Dont believe them - listen to us instead! ”) and so it will be important, but very difficult, to try to inhibit the sending of such minority messages. It would be inappropriate and unenforceable at the present time to try to introduce legislation restricting the sending of SETI messages, but steps have already started through UNCOPUOS (United Nations Council on Peaceful Uses of Outer Space) to establish a process for deciding how and when to send such a message.

## 6. Message Extraction

Once the SETI signal is confirmed, worldwide interest is likely to be such that a number of research groups around the world will work on the signal, trying to extract information from it, and conducting other follow-up research. As far as possible, all such research should be placed in the public domain (e.g., via the Los Alamos astroph exploder).

A SETI signal can be classified according to how much information it contains (or, specifically, the logarithm of the number of bits of information), as shown in Table 1.

Table 1. Table 1: Classes of SETI Detection

Type <i>log(# bits)</i>	# bits of Info.	Example	What We Learn
1	1-10	Simple detection of unmodulated, Doppler-shifted, CW	<ul style="list-style-type: none"> <li>• Presence or absence</li> <li>• Level of technology</li> <li>• Planet/star type?</li> </ul>
2	10-100	<ul style="list-style-type: none"> <li>• Nav beacon</li> <li>• Radar</li> </ul>	<ul style="list-style-type: none"> <li>• Level of technology</li> </ul>
3	100-1000	<ul style="list-style-type: none"> <li>• Simple coded broadcast</li> <li>• Traffic control</li> <li>• Communication fragment</li> <li>• “Alert” message</li> </ul>	<ul style="list-style-type: none"> <li>• Type of technology</li> <li>• Transport systems?</li> <li>• Culture?</li> </ul>
4 (encyclopaedic)	> 1000	<ul style="list-style-type: none"> <li>• Complex broadcast (e.g., TV channel)</li> <li>• Targeted download (e.g., “Contact”)</li> </ul>	<ul style="list-style-type: none"> <li>• Everything!</li> </ul>

Even a Type 1 detection can yield a surprising amount of information about its origin. For example:

- Is it near-field (solar system) or far-field (another star)?

- Can we identify the star or source of the signal?
- What does the stability and spectral shape of the signal tell us about its originating technology?
- Is there a Doppler shift on the signal, telling us about the orbital motion of its originating body?

However, the hope is that there may be other information encoded on the signal. If that is present, the task of decoding the message, given that the language constructs and underlying cultural assumptions may be quite alien to us, and that the originating civilisation is likely to be billions of years older than us (Norris 2000), is likely to be a very long-term task, occupying some of our finest minds and most powerful computers.

## 7. Conclusion and Future Directions

The SETI Post-Detection Committee already exists and is ready to offer advice and leadership in the event of a SETI detection. However, it is not static. In particular, some of the challenges remain unsolved, and there are no doubt other potential issues and challenges which have not yet been discussed, and are not yet covered by contingency plans. Although the PDC membership is broad, it does not yet cover all relevant areas, and expressions of interest in joining the PDC are invited from experts in the following areas:

- Radio Frequency Interference Analysis
- Cryptography
- Information Science
- Internet Robustness
- Media
- Law

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