The Haystack.
The “Haystack” can be thought of as the real search space (the universe) or as the mediated version rendered onto hard-drives for subsequent processing [see 1]. In essence, when looking for ETI, or for life elsewhere (ETL), increasing the capabilities of the instrument(s) will increase the quantity of data to be searched. So, in the context of SETI “Building SKA is building a bigger haystack.” [2] The search task is possibly made more difficult using SKA – not easier. It can be made more manageable by reducing the size of the haystack either in absolute terms but briefly (in order to trial software) or by redefining “Needle” in such a way as to reduce the search space. SETI is bedevilled by poorly justified needles. There are some in the field who argue that because we cannot know about ETI we should not have a notion of needle; we should look in a generic sense for artefacts in the radio-sphere (assuming radio-SETI). I believe open-ended unconstrained searching is ultimately unscientific. We can develop targeting notions which redefine the needle and which cut down the search space in order to identify either an artefact or a null result. Such a search paradigm has been proposed and used on a small scale. [3] And in any case, it is possible to know things about ETI so the “reasonless searching” of poorly conceived SETI is ill-informed. [4]

Search Parameters.
Poorly justified needles.
- Reasonless searching rests on the “argument” that we don’t know what we are looking for so we’d better look everywhere for anything. The difficulty with this is that recognizing an artefact – the needle – as such is going to be very challenging if we have no preconception whatsoever about the needle. Measurement without any expectation at all is really problematic, and statistical evaluation of “results” likewise difficult.
- We don’t know that we haven’t missed a signal. [2]
- Increasing the size of the haystack may expose weaknesses in parameter selection (needle specification). For example, targeting Habstars [3] looks weak if, as is now thought to be the case, planetary systems around stars are commonplace.

Search parameter refinement.
- If we are looking for radio transmissions it makes sense to attempt to specify what sort of signal we expect to detect (it has to be recognisably artefactual).
- And from what direction. We should, in short, attempt to define how and why we might be a target for ETI’s efforts, and use those insights to refine the search parameters. This will reduce the haystack problem.
- Importantly, careful constraints on search parameters enables the null result to be defined and recognized.
- Note that detection need not presume targeted transmissions and this permits different specifications of potential needles for ETL in comparison with ETI.
Life Signatures.
Problematic at RF – but probably not impossible. For example, RF absorption spectra showing presence of OH radicals could be sought through observing exoplanet transits. The search would be done using already identified exoplanets with known transit periods etc. SKA could be particularly useful for this. Likewise, if we assume watery/rocky habitable planets like ours then their atmospheres will have a “water hole” in the spectral transparency properties, like ours. The search for life signatures provokes useful modelling of life support conditions as precursors for life. SKA makes it sensible to ensure that such modelling includes the RF portion of the EM spectrum.

Technosignatures.
In the RF portion of the EM spectrum this probably means the Babble-Bubble of leaked radio, radar and TV transmissions (thinking of our own planet). Microwave “noise” located in particular bands could indicate mobile phone use across our planet, and if such noise is one of our technosignatures it could be sought elsewhere.

Detection vs Contact.
Detection of life (intelligent or otherwise) elsewhere in the galaxy, using RF, is probably feasible. Ultimately ETI will most likely be found by using humongous optical telescopes. If we assume tremendous technological superiority on the part of ETIs all over the place (as seems to be a widespread assumption) then it is reasonably certain we are known about, and without effort on our part. Contact requires that some sort of specific signal is transmitted with intent, to specific targets, with properties which are predictable, and artefactual. A nearby ETI could do that for us, to help us answer the “Are we alone?” question (they will see at the time of their observation we don’t have a matching humongous optical telescope). Such signals could be thought of as “Contact” even if they only signal presence. [Notions of message exchange are irrelevant through implausibility. Long-distance space travel is not part of any SETI scenario although it can make for good film scripts.]

Targeted searching.
A targeted search paradigm exists, and has been tried on a small scale (so far without success) [3]. The assumption is that pulsars can be used as directional reference points for ETI beacons, and they also provide signal pulse rate information which can be looked for in gathered data. The scheme originally targeted Habstars in specific alignments, as potential stars hosting ETI inhabited planets (now not relevant as exoplanets are thought to be ubiquitous). The generalised paradigm now simply requires every pulsar source to be considered as specification for directions and pulse rates, when looking for narrow band pulses (at, say, the frequencies of H or OH lines) from ETI. This can be done automatically, when finding pulsars with SKA. The plan is for digital signal processing commensal measurement, rather than a pointing commensal measurement (cf. 21cm antenna for SETI@Home using Arecibo).[5] Existing pulsars can be re-examined, and all new ones checked out.


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