Title: A Simple Approach to Handling RFI (adapted from the VLBI2010 Observing Strategies Final Report)

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In this communications intensive world, it is almost certain that problems with RFI will intensify, and although current attention is focused on S-band, other bands will no doubt also be affected in the future. As a result, it is important for geodetic VLBI to develop a strategy to minimize the impact of RFI. Here is a suggestion of a 3-step process:

- To begin, it makes sense to avoid spectral regions that are a problem everywhere on Earth, e.g. commercial satellite downlink and broadcast allocations. Fortunately, with these removed, there are still significant spectral regions available, e.g.
    - 2.69 to 3.4 GHz,
    - 4.8 to 6.7 GHz,
    - 7.75 to 10.7 GHz,
    - 12.75 to 17.3 GHz, and
    - 22.0 to 37.5 GHz.
- Next, when VLBI sites are being selected, low local interference should be set as a criterion. Sites should typically be located away from large urban areas, airports, military installations, communications repeaters, satellite ground stations, etc. Once a good site has been found, working with local regulatory agencies can ensure that within reasonable limits the low RFI situation will continue into the future.
- Finally, the frequency structure used and the DAS design should be robust against RFI. For example,
    - Frequency structures that depend on critically spaced narrow channels should be avoided since RFI can cause serious degradation if even one of the channels is compromised. Broad continuous bands will not have this shortcoming.
    - The DAS should be designed such that only the frequencies affected by RFI will be degraded and not entire broad-band channels. In order to achieve this, a VLBI receiving system needs to have a large dynamic range. Linearity for 30dB above the noise floor would probably be a good rule of thumb. This includes amplifiers, mixer, splitters, etc. and even samplers. Unfortunately, large multi-bit samplers are in conflict with the usual VLBI rule of thumb to never use more than 2-bit samples. This is applied to maximize interferometric information density during data transmission to the correlator. The following process would make it possible to sample with a large multi-bit sampler but still transmit only 2-bit data to the correlator:

- Sample the data with a large number of bits,
- Use a dynamic digital filter to cut out the RFI,
- Requantize to 2-bits,
- Transmit the 2-bit data to the correlator.

Another approach would to be to implement an FX correlator but with the Fourier Transform (F) applied at the station (along with perhaps delay/phase tracking) and only the Cross-multiply (X) applied at the correlator, e.g.:

- Sample the data with a large number of bits,
- Use a polyphase filter and FFT to transform to the frequency domain. A large number of bits is maintained.
- Perhaps perform delay tracking and phase compensation. If performed at this stage, the large number of bits will minimize digital losses and distribute the processing load to the stations.
- Requantize to 2-bits.
- Transmit the 2-bit data to the correlator, where only the cross-multiply will can be applied.

With either of these approaches, only the regions with RFI will be degraded while the rest of the spectrum will be unaffected. In both cases, it is not necessary to detect the RFI at the site and compensate in real time.

The data could then be multi-bit sampled initially and requantized to 2 bits after the Fourier Transform for transmission to the correlator. In this way, only the channels affected by RFI would be degraded.