**This Request for Information (RFI) is specifically for** **the Simulator System required to generate the required GNSS Radio Frequency (RF) signals.**

There are a number of elements to consider within the process of replacing the current MOD Global Navigation Satellite System (GNSS) Simulator System and an upgrade to an Anechoic Chamber Test Facility (ACTF), falling into three broad categories:

* Infrastructure Improvements/Replacement
* Pseudolite Replacement (including cabling)
* RF Signal Generation (GNSS / Interference)

There is also a significant amount of interdependency between these elements and therefore their high-level requirements, which adds complexity.

For the purpose of facilitating responses to this RFI, specifically regarding rough costs and timescales for delivery, the Authority is sharing its understanding of the potential configuration options below.

The Authority considers there to be two fundamental architectures for the future Global Navigation Satellite System (GNSS) Anechoic Chamber Test Facility (ACTF):

* Zonal System: Each pseudolite is responsible for a region of the ceiling and simulates all satellites in its region. This design would be capable of simulating GNSS signals at any time, date, or location.
* Static Constellation: Pseudolites positioned on the anechoic chamber ceiling in a geometry that mimics the satellite positions at a chosen time, date, and location. Each pseudolite has the potential to transmit signals from multiple closely spaced satellites to provide multi-constellation capability while minimising the number of Pseudolites required.

The Authority also conducted investigation into modified versions of these architectures to reduce the hardware requirement or increase the test validity window. This resulted in two further potential architectures:

* Fixed Location Zonal: The number of zones in a zonal system can be reduced by fixing the receiver position sufficiently close (in latitude) to a pole (since GNSS satellite trajectories do not go over the North and South poles there will be a ‘hole’ in the skyplot where satellites never pass and hence zones that do not require coverage).
* Static Plus: This is an augmentation of the static setup, which extends the test validity period by adding additional pseudolites to a static system and allowing some satellite transitions between them.

Independent of the architecture (zonal / static), each simulator pseudolite output would be required to provide the capability to broadcast signals of all constellations and frequencies listed in the requirements table simultaneously (i.e. each pseudolite will be multi-frequency / multi-constellation)

The high-level requirements for the simulator system are:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ID | Requirement | Description / Information | Minimum Specification (Mandatory) | Optimal Specification (Desirable) |
| GSG.1 | Frequencies |  | 1559MHz – 1612MHz (GNSS L1/E1 band)  1215MHz – 1256MHz (GNSS L2 band)  1160MHz – 1214MHz (GNSS L5/E5 band) | Roadmap / scoping information for the feasibility of providing additional future frequencies (if required) |
| GSG.2 | Constellations/Signals |  | GPS:   * All open signals * P * AES M-code   Galileo   * All open signals * Pseudo PRS   GLONASS   * All open signals   Beidou   * All open signals | Provision of or a roadmap (with all necessary permissions and authorisation already in place) to deliver encrypted signals:  GPS:   * P(Y) * M-Code   Roadmap / scoping information for the feasibility of providing additional future constellation and/or signals within existing frequency set. |
| GSG.3 | Beamwidth / Maximum Angular Error | This requirement is likely to impact or be impacted by requirements:   * GSG5 | The maximum subtended angle between the simulated satellite and the pseudolite position is 15° measured from the chamber centre (1m AGL) for the entire validity period. | The maximum subtended angle between the simulated satellite and the pseudolite position is 12.5° measured from the chamber centre (1m AGL) for the entire validity period. |
| GSG.4 | Elevation Mask Angle |  | 5°  This can include a slightly increased mask region (approximately 7°) at the bottom of the hemisphere where total coverage is not enforced (e.g. due to pseudolite positioning there may be a limited number of small gaps where pseudolite coverage does not fully intersect) | 0°  This can include a slightly increased mask region (approximately 7°) at the bottom of the hemisphere where total coverage is not enforced (e.g. due to pseudolite positioning there may be a limited number of small gaps where pseudolite coverage does not fully intersect) |
| GSG.5 | Test Validity Period | This requirement is likely to impact or be impacted by requirements:   * GSG3 | 40 minutes | ∞ - acknowledging that fidelity will reduce over time |
| GSG.6 | Coverage |  | Fixed location (Boscombe Down Chamber)  Fixed date and time | Global  24/7/365 |
| GSG.7 | Wavefront Simulator |  | Flexibility to reconfigure the hardware to provide a Wavefront Simulator capability for Antenna Electronic Unit testing. |  |

The MOD study concluded that:

* A Full Zonal setup would require 43 pseudolites for 30° beamwidth and 55 pseudolites for 25° beamwidth. Fixing the receiver location to Boscombe Down leads to a decrease in the number of pseudolites needed to 36 and 50 pseudolites respectively.
* A Static multi-frequency, multi-constellation ACTF set-up with a similar validity period to the current GPS set-up (40-50 minutes) is achievable with 15 pseudolites for 30° beamwidth and 20 pseudolites for 25° beamwidth.
* Extending the Static setup into a Static Plus configuration by adding 6/7 additional pseudolites can extend the static validity period by 50-100% (an additional 20-40 minutes) and a full hour extension can be achieved for between 13 – 18 additional pseudolites.

MOD has assumed that the hardware required to generate the required GNSS RF signals (independent of the configuration deployed) will be the key driver in the overall system cost.

For the Authority to understand and evaluate the estimated costs for this potential future requirement, in addition to any configuration suggestions, ideas and technical information shared, it is requested that estimates cost are provided to generate GNSS RF signals for:

1. a 15 pseudolite system
2. a 26 pseudolite system
3. a 55 pseudolite system