# 5GIF Sharing Studies Activities

5th ISMC, New Delhi
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# About Amrita University

**10 campuses spread across India**

Coimbatore, Amritapuri (Kollam), Kochi, Bengaluru, Mysuru, Amaravati, Chennai, Faridabad (NCR), Nagercoil, and Haridwar






Very reach in feature –R16, R17 included

# 5G-6G Innovation and Research Lab

# Skilling and Training

## PROGRAM CATALOGUE

01 **6G Essential Training & Certification**
Duration: 16 Hour
Pre-requisite: None

02 **5G Technology Certification**
Duration: 16 Hour
Pre-requisite: None

03 **5G Essential for Business Executive**
Duration: 16 Hour
Pre-requisite: None

04 **5G Technology Deep Dive**
Duration: 40 Hour
Pre-requisite: 5G Technology Certification

05 **5G Protocol Testing & Log Analysis**
Duration: 40 Hour
Pre-requisite: 5G Technology Certification

06 **5G Development Certification**
Duration: 40 Hour
Pre-requisite: 5G Technology Certification with basic understanding of programming

07 **5G Core Overview Certification**
Duration: 24 Hour
Pre-requisite: None

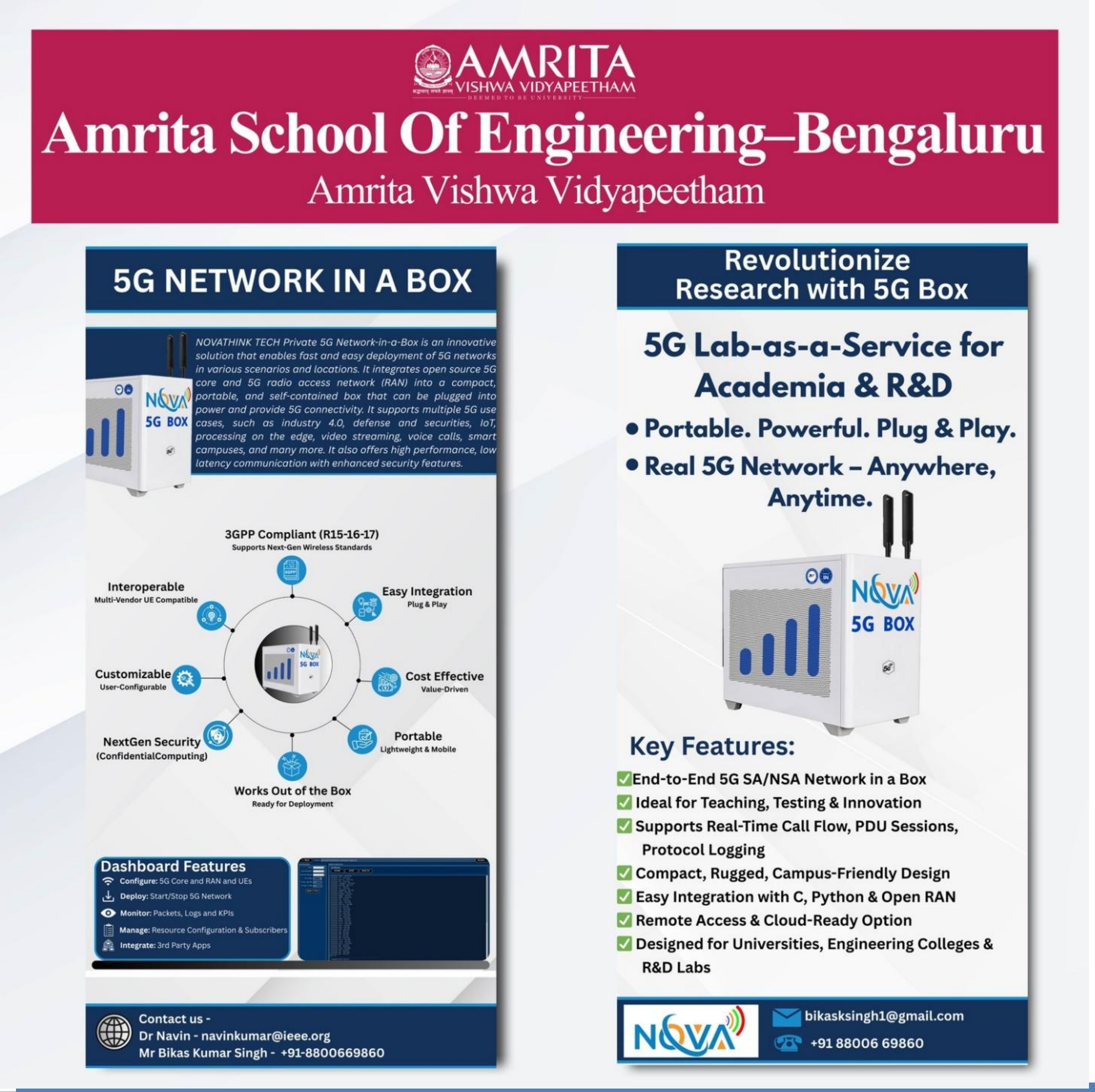
08 **5G Core Deep Dive with Protocol Analysis**
Duration: 40 Hour
Pre-requisite: None

09 **5G Network Optimization in Depth**
Duration: 60 Hour
Pre-requisite: 5G Technology Certification

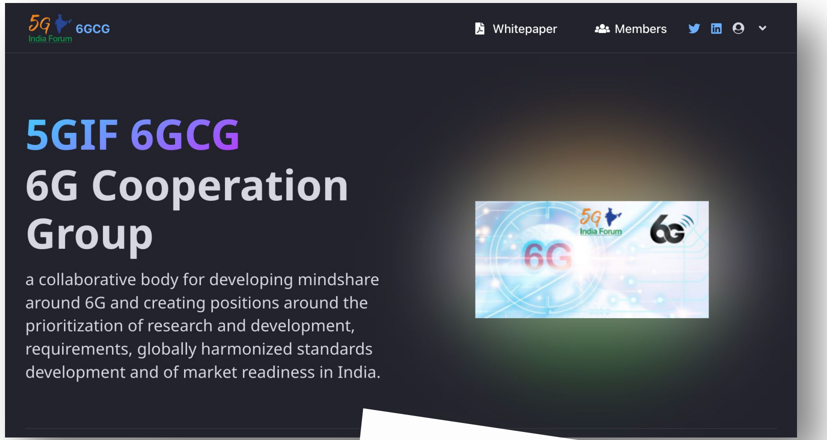
10 **5G ORAN Certification**
Duration: 40 Hour
Pre-requisite: 5G Technology Certification

11 **5G Telco Cloud Certification**
Duration: 40 Hour
Pre-requisite: 5G Technology Certification

12 **4G/5G Automation with Python & AI**
Duration: 40 Hour
Pre-requisite: 5G Technology Certification



# 5GIF Engagements



## Completed Activities

- Satellite IMT-2020 Evaluation (WP4B)
- Report and results available online (https://satimt2020.5gindiaforum.in/)
- ITU-R – IMT-2020 Evaluation Group
- NuFront Evaluation for WP5D

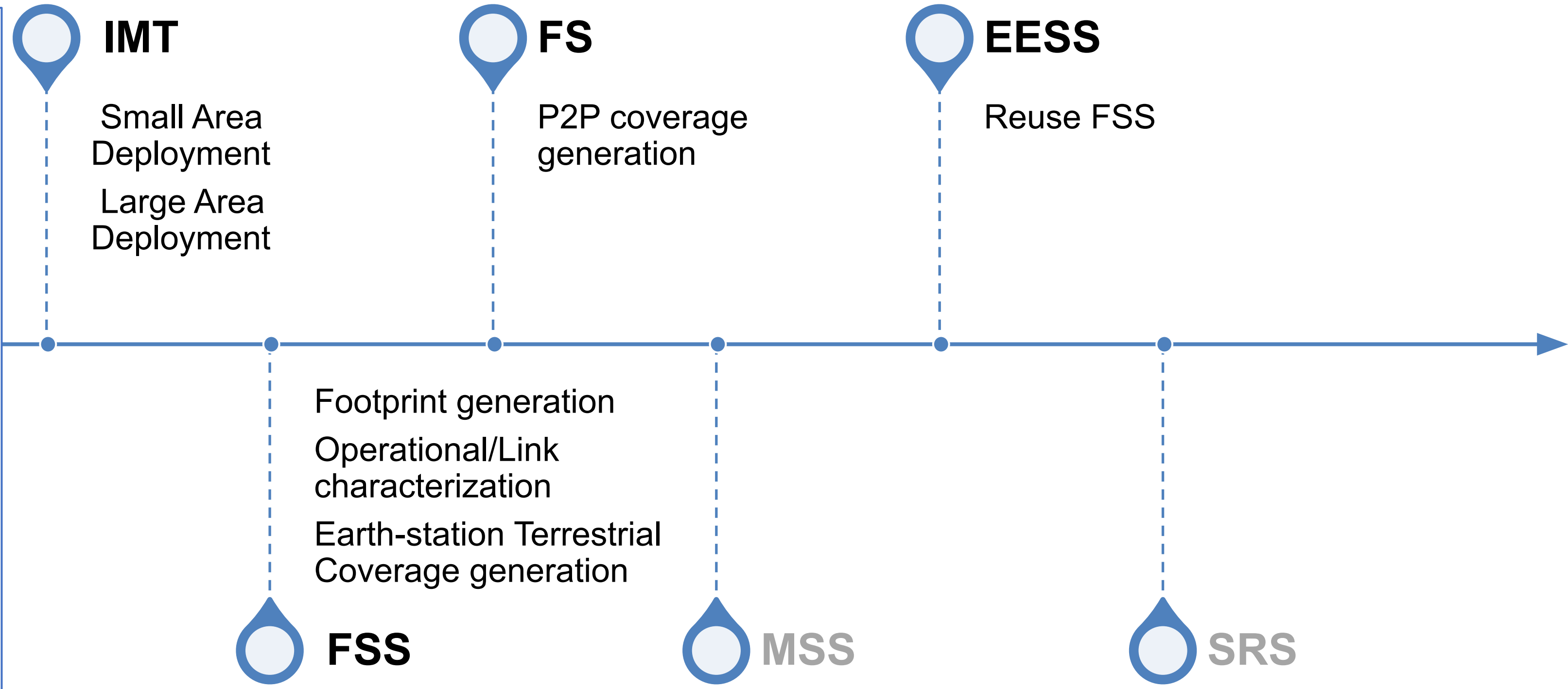

## Sharing Studies

- Support development of tools
- Portal for online analysis, model access will be available

# Developing Software Tools for Inputs to National Preparation

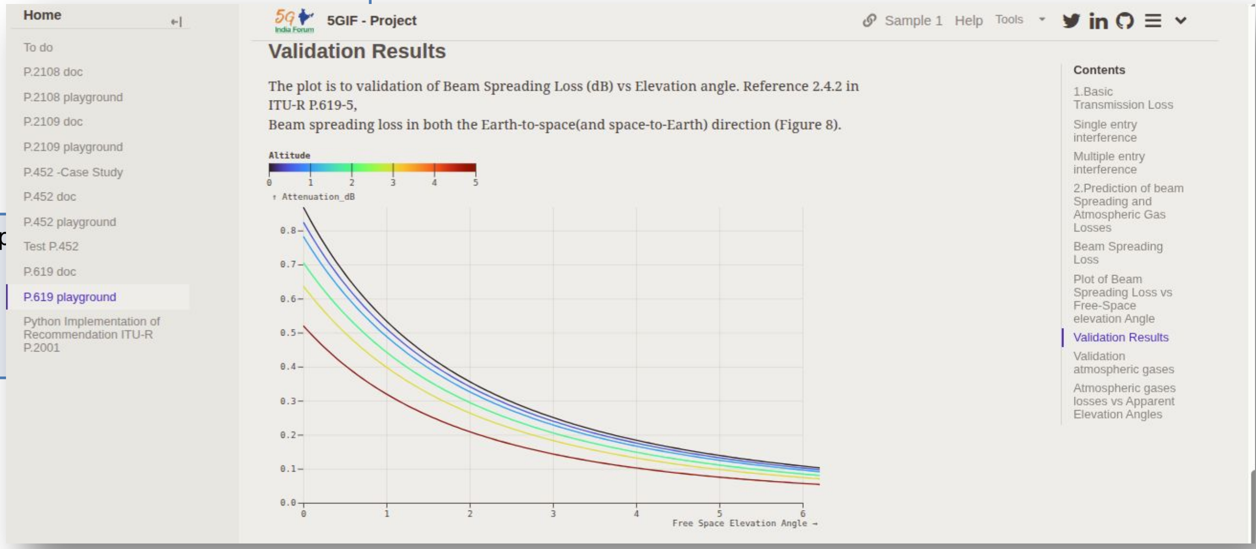
- Reuse Model implementation
- Compatibility for UI /interactivity
- Input specification
  - ITU-R based Characteristics
  - JSON based
- Output specifications
  - *CSV, JSON*
  - Additional, interim statistics

- Independent ITU-R Propagation models
- Independent ITU-R Antenna Model
- Documentation and example usage



# ITU-R Propagation Models

| Name | Title | Remarks |
|---|---|---|
| ITU-R P.619 (including ITU-R P.676) | Propagation data required for the evaluation of interference between stations in space and those on the surface of the Earth. Includes (Attenuation by atmospheric gases and related effects ) | Implementation available<br>• Basic transmission loss for single-entry interference<br>• Prediction of beam Spreading and Atmospheric Gas Losses |
| [ITU-R P.2108]() | Prediction of clutter loss | Implementation available<br>• Height gain terminal correction model<br>• Statistical clutter loss model for terrestrial paths<br>• Earth-space and Aeronautical statistical clutter loss model |
| [ITU-R P.2109]() | Prediction of building entry loss | Implementation available<br>Building Entry Loss Model |
| ITU-R P.452 | Prediction method for the evaluation of interference between stations on the surface of the Earth at frequencies from about 0.1 GHz to 50 GHz, accounting for both clear-air and hydrometeor scattering interference mechanisms.<br>Designed to calculate propagation losses not exceeded for time percentages over the range 0.001 <p < 50%. | Implementation available<br>Prediction of interference between earth surface |
| ITU-R P.2001 | Describes a general-purpose, wide-range terrestrial propagation model for frequencies between 30 MHz and 50 GHz, encompassing various propagation scenarios and distance | Implementation under p |



# ITU-R IMT Modelling

5G India Forum

**IMT Specification Related parameters**

- Channel, Signal BW
- Tx, Rx Characteristics
  - o Emission Mask
  - o Output Power
  - o Power dynamic (BS,UE)
  - o Noise Figure
- Sensitivity, SINR Operating range
- SINR Range DL,UL
- Band 1 For e.g., : DL[-10,30], UL [-10,22]

*Band specific

3GPP TS 38.104 (BS)
3GPP TS 38.101 (UE)

IMT Deployment Characteristics
For typical deployment (U,SU,RU) specific to bands

- AAS in all three bands for BS
- Non-AAS for 4.5,7/8 for UE
- Paramters like :
- BS Antenna height,
- Sectorization
- Rooftop etc.,
- Channel BW
- N/w loading
- UE target power/RB, simultaneous UL NUES
- Indoor:Outdoor Ratio
- TDD Activity Factor
- BS Density, dependency on Footprint understudy

For e.,g : Some bands contiguous coverage is not expected in rural areas, and any such base stations that may exist in small numbers will be isolated installations at specific locations, and therefore, the rural deployment environment may or may not be included in the sharing and compatibility studies For e.g., 0.001-0.006 BS per km2.

Antenna Characteristics
IMT AAS BS
*Described in ITU-RM.2101*

- Introduced **sub-array geometries** with fixed down-tilt
- Parameters for *Rural, MacroSubUrban,MicroUrban, Smallcell/MicroUrban, smallcell-IN/MicroUrban*
- *FrontToBackRatio,*
- *ElementGain*
- *BW3dB*
- *Polarization*
- *ArrayConfigurations : (Env based)*
- *#Elem in rows in sub-array*
- *Sub-array Dtilt (3degree)*
- *Conducted power 28dBm/subArray*
- *EIRP Typical : 72.2dBm*
- *BS Hor-coverage +-60*
- *BS Vert-Coverage 90-120*
- *Mech Tilt : 3-10*

8 x 16 means there are 8 rows and 16 columns of radiating sub-arrays for macro suburban and macro urban cases. 8 × 8 means there are 8 rows and 8 columns of radiating elements for the small cell outdoor/micro urban case.

JSON format

IMT Model Library

*IMTmodel.js*

- Small Area/Large Area
- IMT BS antenna gain towards a ***(theta,phi)***
  - o *theta,phi irrespective of towards Space or Ground stations*
- *Modes of output*
  - o *Sample Instance*
  - o *Statistical Instance*
- *Ability to map IMT stations relative locations (cartesian) to lat,long (absolute locations)*


```
▾Object {
  Type: "Macro Suburban"
  AntennaPatternModel: "Table 17 (Extended AAS Model)"
  ElementGain_dBi: 6.4
  3dBBeamwidth: ▸Object {Horizontal: 90, Vertical: 65}
  FrontToBackRatio_dB: ▸Object {Horizontal: 30, Vertical: 30}
  AntennaPolarization: "Linear ±45° polarized sub-array"
  AntennaArrayConfiguration: ▸Array(2) [8, 16]
  Subarrayspacing: ▸Object {Horizontal: 0.5, Vertical: 2.1}
  ElementSpacing: ▸Array(2) [0.5, 0.7]
  Msub: 3
  BeamEtilt: 3
  ArrayOhmicLoss_dB: 2
  ConductedPowerPerSubArray_dBm: 22
  hRange: ▸Array(2) [-60, 60]
  vRange: ▸Array(2) [90, 100]
  mTilt: 6
  TypicalBaseStationOutputPowerPerSector_dBm: 78.3
}
```



```
▾Object {
  Type: "Macro Suburban"
  AntennaPatternModel: "Table 17 (Extended AAS Model)"
  ElementGain_dBi: 6.4
  3dBBeamwidth: ▸Object {Horizontal: 90, Vertical: 65}
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  mTilt: 6
  TypicalBaseStationOutputPowerPerSector_dBm: 78.3
}
```


*IMT-AAS_char.json*


```
ect {
e: "Macro Suburban"
ennaPatternModel: "Table 17 (Extended AAS Model)"
mentGain_dBi: 6.4
Beamwidth: ▸Object {Horizontal: 90, Vertical: 65}
ntToBackRatio_dB: ▸Object {Horizontal: 30, Vertical: 30}
ennaPolarization: "Linear ±45° polarized sub-array"
AntennaArrayConfiguration: ▸Array(2) [8, 16]
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hRange: ▸Array(2) [-60, 60]
vRange: ▸Array(2) [90, 100]
mTilt: 6
TypicalBaseStationOutputPowerPerSector_dBm: 78.3
}
```
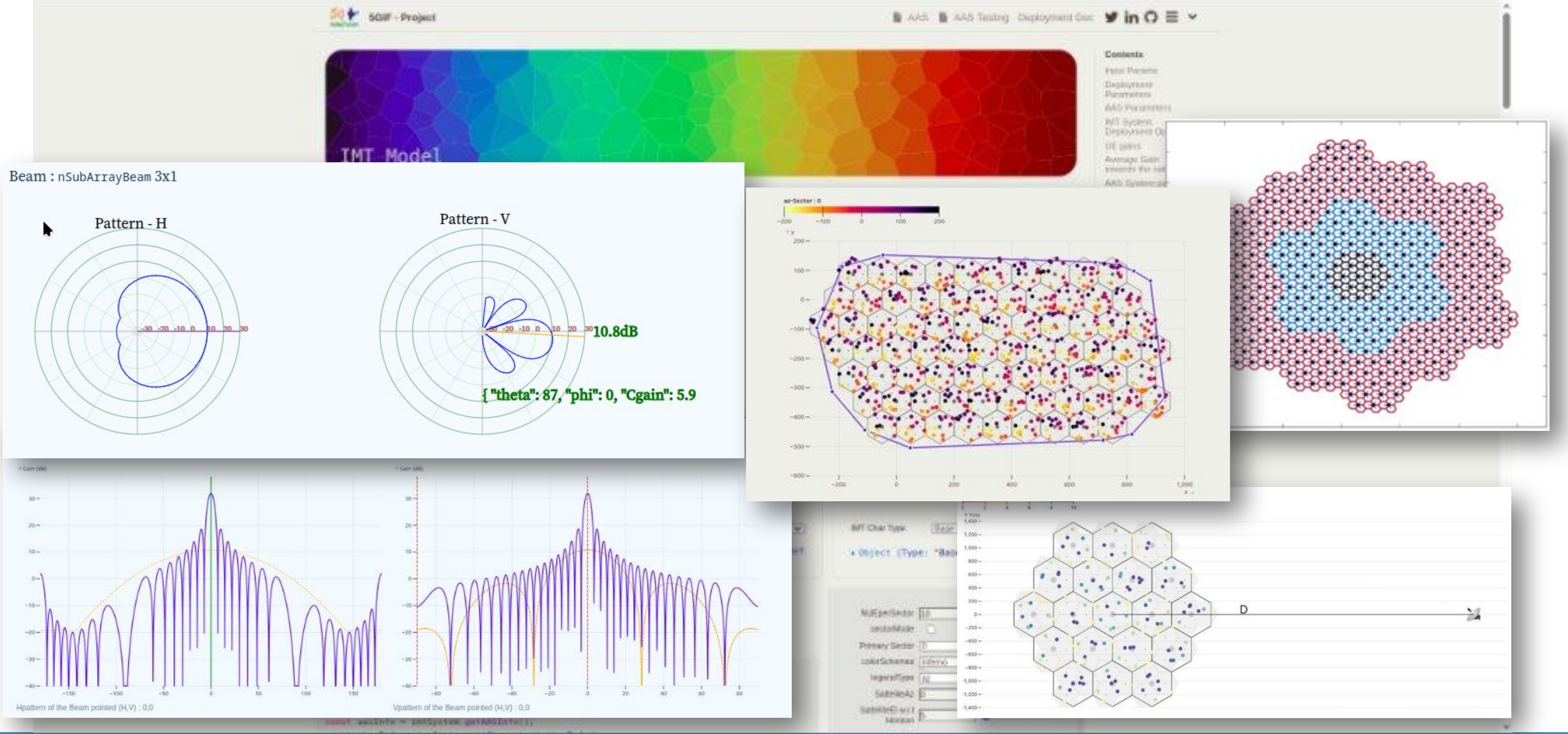

# AAS & Deployment Modelling



# ITU-R FSS Modelling

*FSS SS Configuration*


```
▾Object {
  Type: "Macro Suburban"
  AntennaPatternModel: "Table 17 (Extended AAS Model)"
  ElementGain_dBi: 6.4
  3dBBeamwidth: ▸Object {Horizontal: 90, Vertical: 65}
  FrontToBackRatio_dB: ▸Object {Horizontal: 30, Vertical: 30}
  AntennaPolarization: "Linear ±45° polarized sub-array"
  AntennaArrayConfiguration: ▸Array(2) [8, 16]
  Subarrayspacing: ▸Object {Horizontal: 0.5, Vertical: 2.1}
  ElementSpacing: ▸Array(2) [0.5, 0.7]
  Msub: 3
  BeamEtilt: 3
  ArrayOhmicLoss_dB: 2
  ConductedPowerPerSubArray_dBm: 22
  hRange: ▸Array(2) [-60, 60]
  vRange: ▸Array(2) [90, 100]
  mTilt: 6
  TypicalBaseStationOutputPowerPerSector_dBm: 78.3
}
```


**Antenna Size,**
**Antenna Pattern etc.,**
**Rx Gain**

**GSO Satellite**
- Orbital Position (Lng)
- Height (km)
- Pointing Location, (Lat,Lng)
- Input param (3dB, xdB), footprint

**Non-GSO Satellite**
- Orbital Position (Lng)
- Height (km)
- Pointing Location, (Lat,Lng)
- Input param (3dB, xdB), footprint

JSON format

FSS Module Library

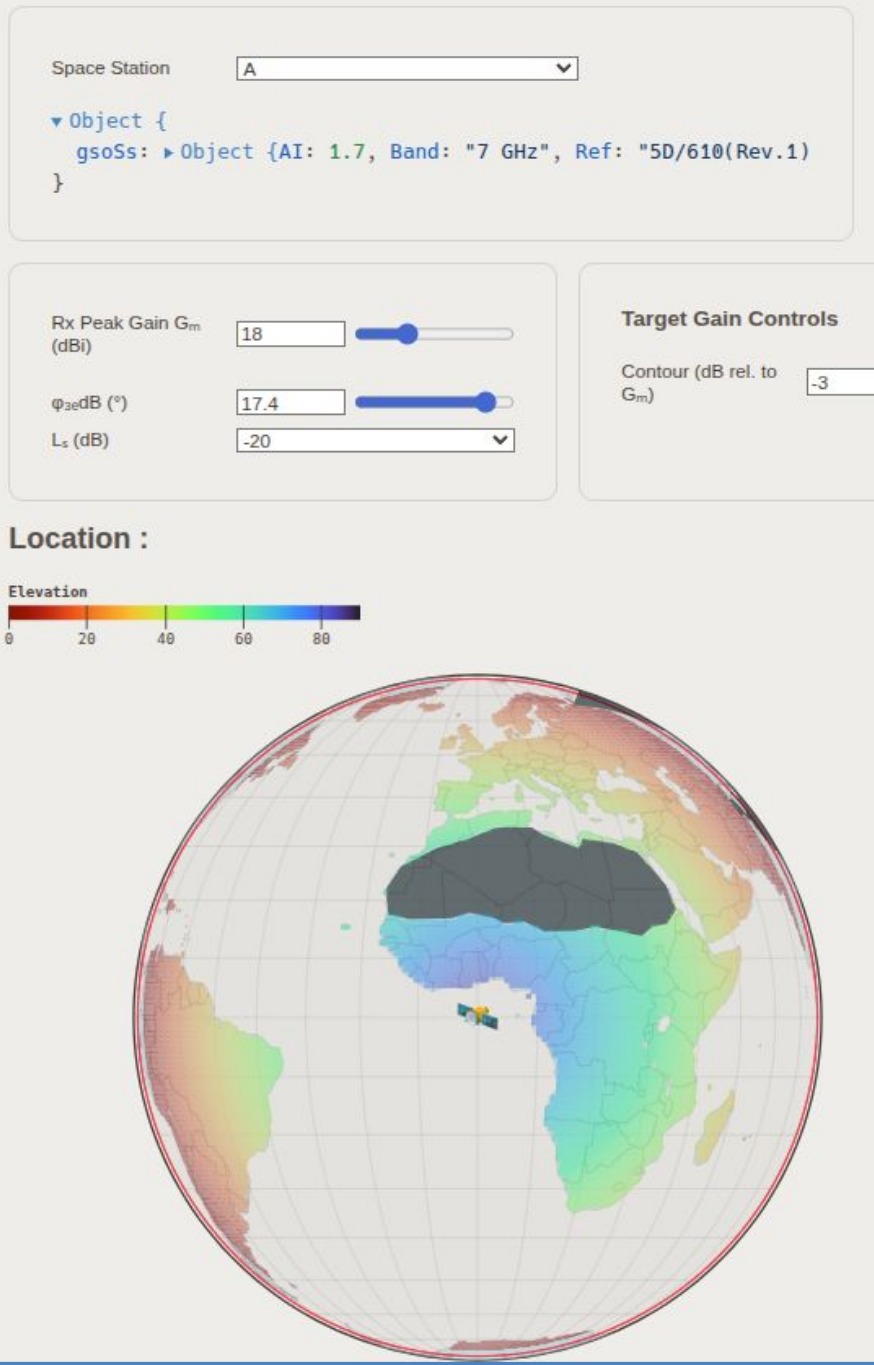
*FSSmodel.js*

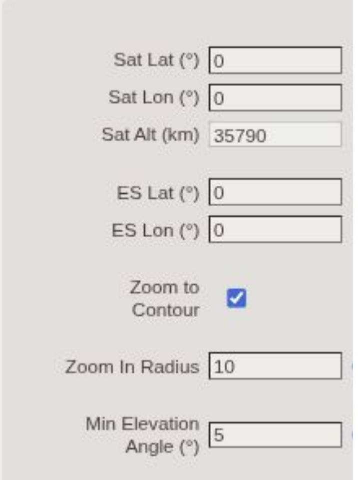
Ability to identify water area, unpopulated area, desserts, etc within the footprint.

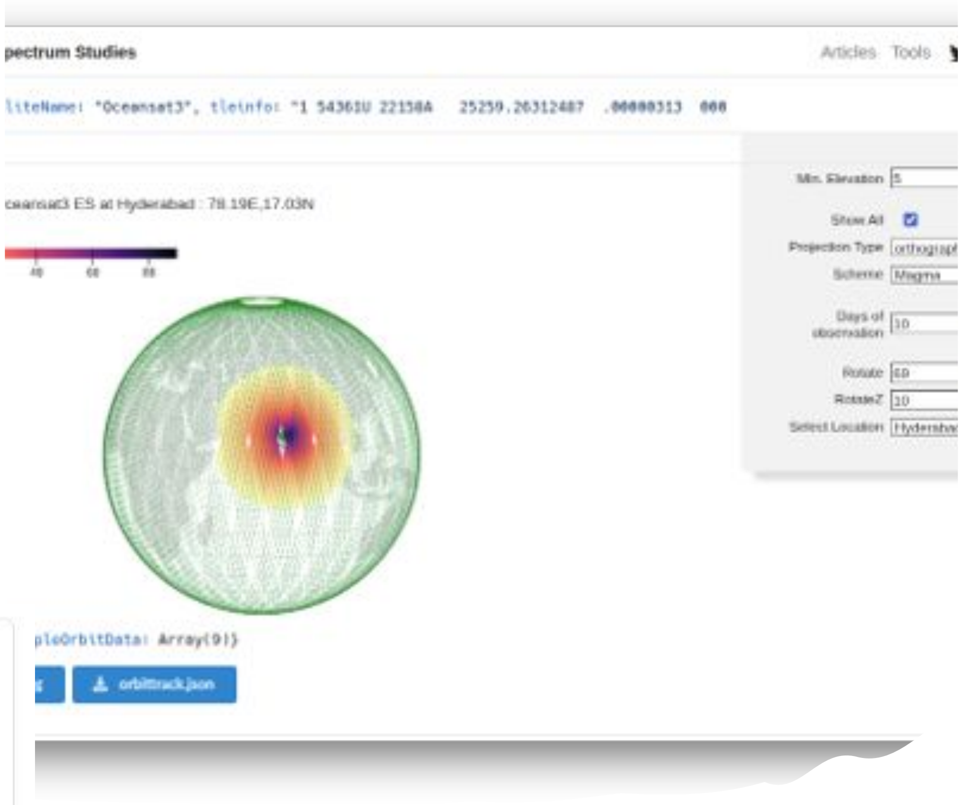
Create exclusion zone

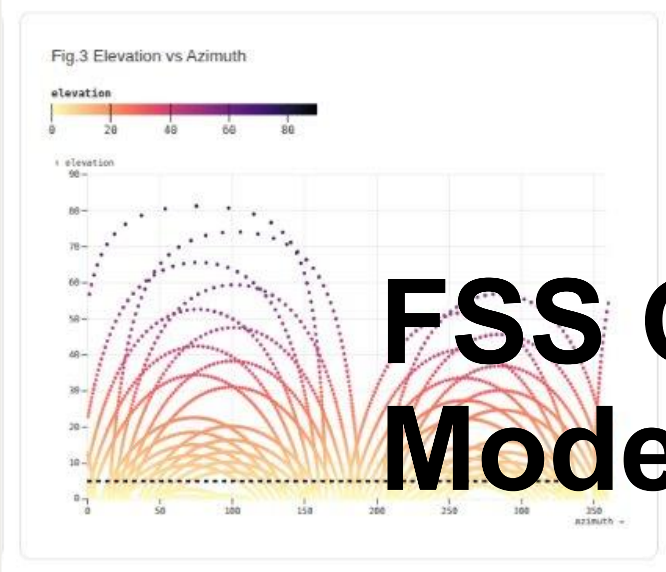
**GSO**
- Polygon of points on earth surface @ xdB of main-beam of the satellite
- Elevation angles for each grid towards the satellite
- Elevation,Azimuth angles for each grid towards the satellite

**Non-GSO**
- Main Beam Point Location over a period
- Moving Footprint over earth surface
- Polygon of points on earth surface @ xdB of main-beam of the satellite **(Variable ?)**
- Elevation,Azimuth angles for each grid towards the satellite



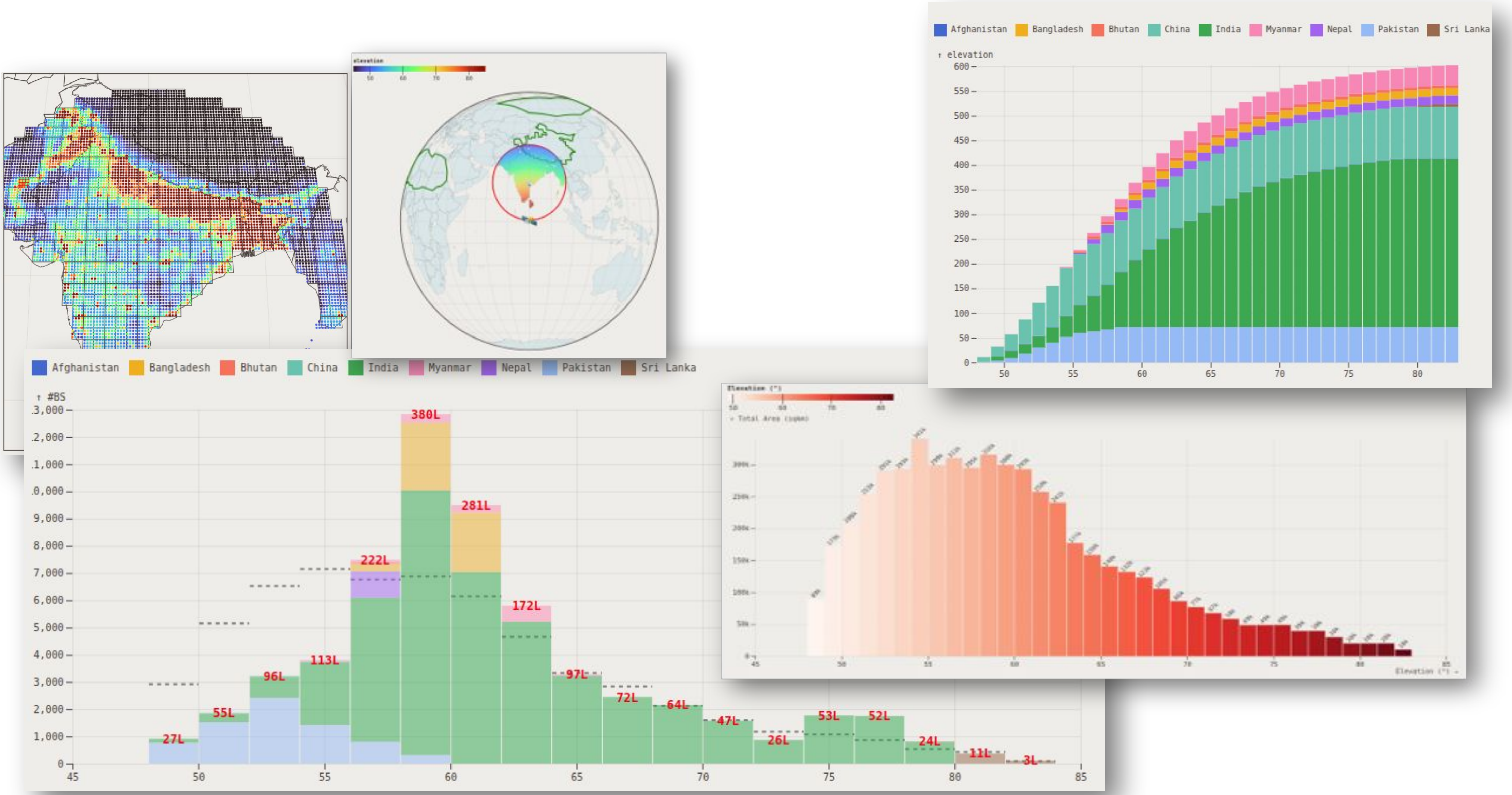



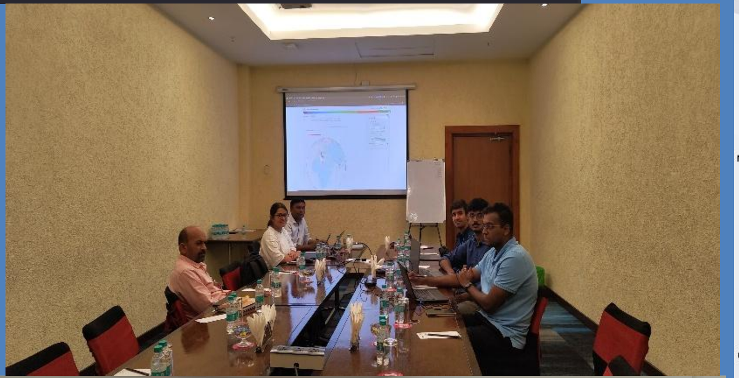

# FSS GSO and NGSO Modelling

# Support for SEDAC Population Redistribution



5GIF - Spectrum Studies
Articles
Tools
5GIF Spectrum Studies
Welcome to the dedicated portal of 5GIF's spectrum study activites


# Thank You



NovaThinkTech
Consultancy
5G
NovaThinkTech 5G Box
NOVA TECH Private 5G Network-in-a-Box is an innovative solution that enables fast and easy deployment of 5G networks in various scenarios and locations. It integrates open source 5G core and 5G radio access network (RAN) into a compact, portable, and self-contained box that can be plugged into power and provide 5G connectivity. It supports multiple 5G use cases, such as industry 4.0, defense and securities, IoT, processing on the edge, video streaming, voice calls, smart campuses, and many more. It also offers high performance, low latency communication with enhanced security features.
3GPP Compliant (R15-16-17)
Supports Next-Gen Wireless Standards
Interoperable
Multi-Vendor UE Compatible
Easy Integration
Plug & Play
Customizable
User-Configurable
Cost Effective
Value-Driven
NexTGen Security
(ConfidentialComputing)
Portable
Lightweight & Mobile
Works Out of the Box
Ready for Deployment
Dashboard Features
Configure: 5G Core and RAN and UEs
Deploy: Start/Stop 5G Network
Monitor: Packets, Logs and KPIs
Manage: Resource Configuration & Subscribers
Integrate: 3rd Party Apps
Contact us -
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Mr Biakas Singh -