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LS OF SOUTH AFRICA OVERVIEW

LS of South Africa's prides itself in its offering of in-flight RF antenna radiation pattern characterization, RF scanning services and site auditing with 3D Tower visualization. LS of SA's unique RF measuring capability, using adapted Remote Piloted Aircraft Systems (RPAS), have repeatedly done service in Africa, Europe, Scandinavia, South America, North America, and Asia.

Where LS of SA supports its spatial RF measuring services with airborne site inspections/ morphology modelling, a powerful information pool is also established for regulatory, planning, and operational purposes in the telecommunications industry.

LS of SA is licensed by the South African Civil Aviation Authority (SACAA) as a commercial RPAS services provider. The SACAA accreditation, RPAS Operating Certificate and Air Service License is recognized internationally and will be provided on request. LS of SA is fully insured for all flights.

Prescribed operational regulations as per SA - CAR101 are adhered to during flight operations. Such protocols, amongst others, require written approvals from site owners per site for flight operations before measurement flights may commence.

RF MEASUREMENTS

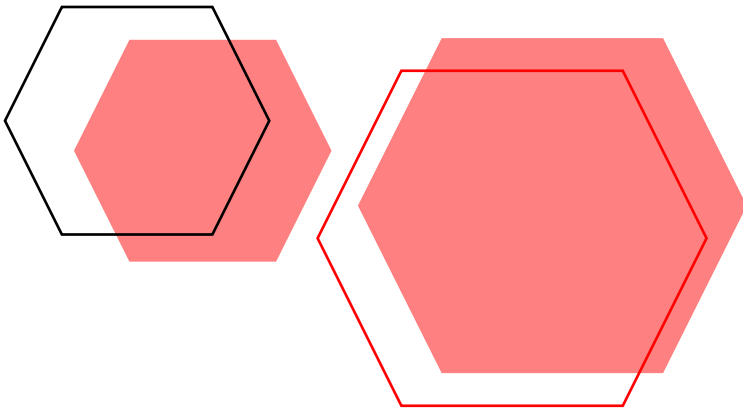
LTE AND 5G MEASUREMENTS

LS provides a unique RF mobile measurement service for both LTE and 5G technologies. LS developed an RPA solution to be able to measure and extract important RF and demodulated parameters in the face of the antenna. This allows highly accurate delivery of:

LTE RPA MEASUREMENTS

LTE downlink broadcast channels are demodulated to obtain information regarding LTE transmission. Each LTE sector (Cell ID) are then analyzed individually due to variations in heading, tilt, EIRP and beam width. The following can therefore be generated:

- Demodulated broadcast channel parameters synchronized with highly accurate GPS position
 - RSRP, RSSI, RSRQ
 - EARFCN, Cell ID, Physical Cell ID, Channel Bandwidth, Duplex Mode, # Antennas, PLMN Count, MCC/MNC, Country, Network (Service provide)
- Sectorized antenna radiation pattern display
- Combined sector 3D radiation pattern display
- Individual sector 3D radiation pattern display
- EIRP (Effective Isolated Radiated Power) calculation



5G NR RPA MEASUREMENTS

A demand for 5G NR site analysis has become a crucial part of the 5G roll out process. Due to the complexity of 5G NR massive MIMO antenna systems, it is necessary to be able to demodulate and analyze every transmission beam per sector of a 5G mobile site.

5G massive MIMO antennas consist of multiple beams (primarily 8), over which the primary and secondary synchronization signals sweep. The 5G NR RPA system of LS enables demodulation of these synchronization signals over 8 beams simultaneously to be able to extract usable parameters for analysis. With this information it is possible to generate: - (See next page):

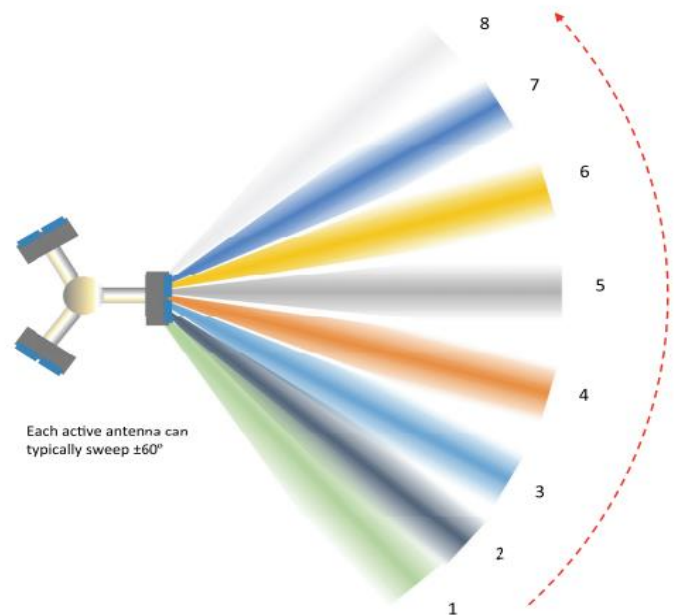
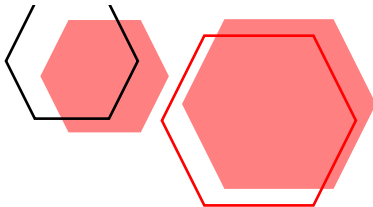
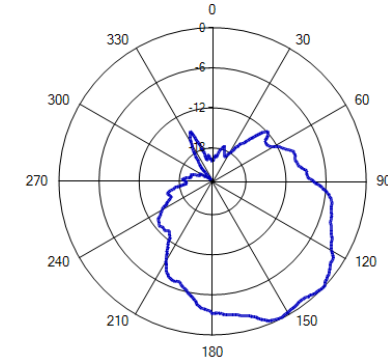


FIGURE 1: PRIMARY SYNCHRONISATION SIGNAL STEP SWEEPING ACROSS ANTENNA BEAMS (REF: [HTTPS://DL.CDN-ANRITSU.COM/EN-US/TEST-MEASUREMENT/FILES/APPLICATION-NOTES/APPLICATION-NOTE/11410-01160A.PDF](https://dl.cdn-anritsu.com/en-us/test-measurement/files/application-notes/application-note/11410-01160A.pdf))

- Demodulated synchronization parameters synchronized with highly accurate GPS position
 - Channel power and channel power spectrum density
 - Physical Cell ID information
 - Cell ID,
 - Frequency Error,
 - detected beams and
 - sector ID
 - Synchronization Signal Block information
 - Beam power and EVM for
 - RS-PBCH, PBCH, PSS, SSS channels
 - SS-RSRP, SS-RSRQ, SS-SINR
- Constellation data collection
 - Modulation type
 - IQ pairs per selected beam



3D MODELLING

COMPLETE 3D MODELLING AND VISUAL REPRESENTATION

Site Modelling and Visual Data Capture (including Mobile radio and Broadcast site auditing)

LS of SA offers a 3D modelling service whereby the site infrastructure is rendered and represented using photogrammetry and Lidar. High resolution photographs of all site and mast elements are available for any portion of the 3D model of the site and this allows the customer to “virtually” scrutinize the 3D rendered model in the comfort of their office. This service is particularly suited for the determination of installation quality, operational integrity and rental capacity on mast structures and sites. Site element dimensions and spatial positions can also be accurately determined.

The service is also offered in synergy with LS of SA’s spectral measurement airborne services.

Recordings can be done of equipment mounted on the mast, the site layout and for the various site services such as power line routes and roads. Deliverables might be outputted in various formats.



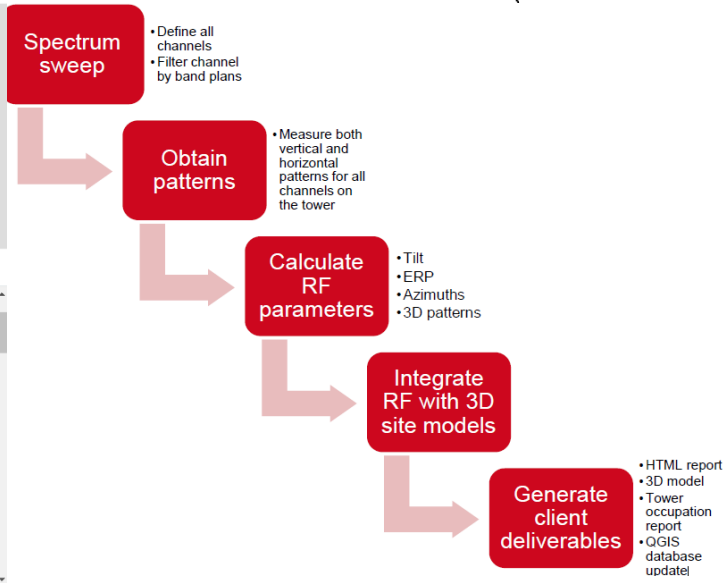
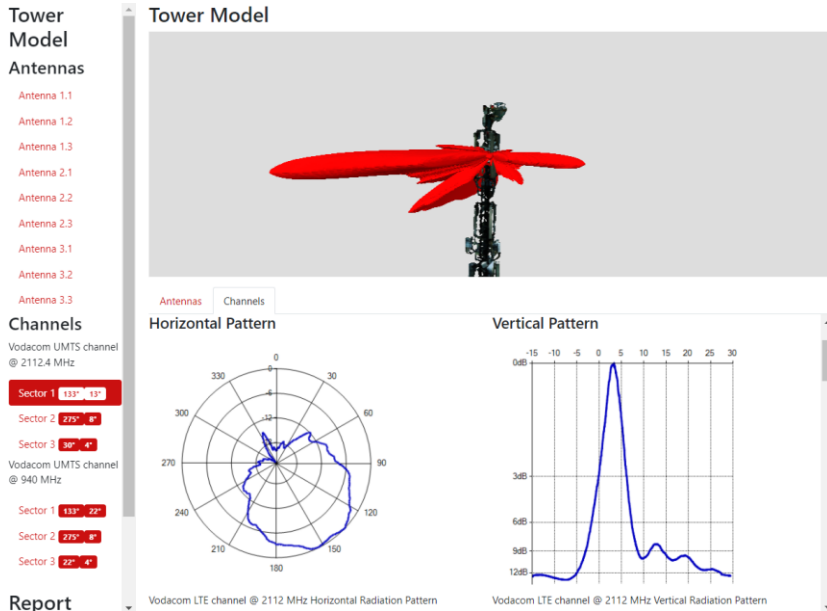
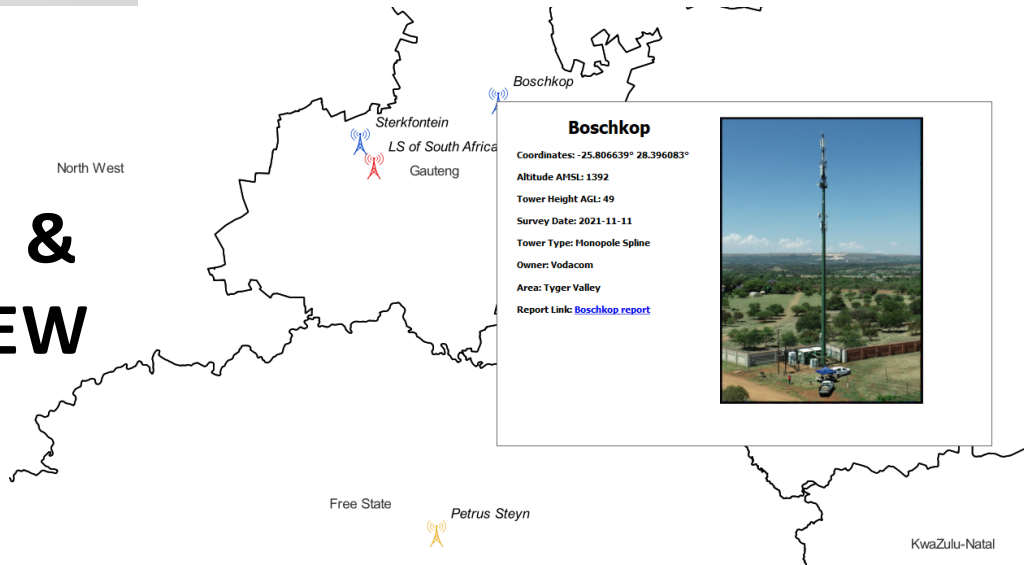
Such records are extremely valuable for both infrastructural -, operational -, and audit purposes.

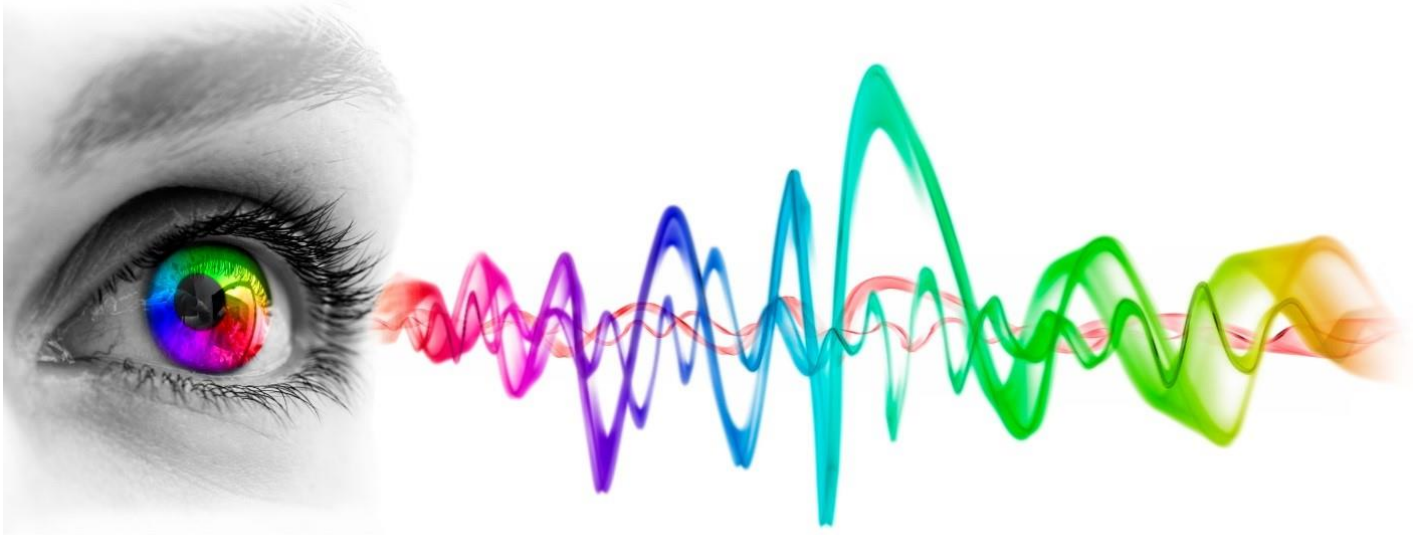
Examples of site elements that might be included in the modelling procedure are:

- Mast occupancy (antenna count)
- Site occupancy (buildings, containers structures satellite antennas)
- Site grounds conditions (crush stone, weeds, erosion, etc.)
- Mast condition (rust, wind damage, loose attachments, access doors, cables and cable trays, etc.)
- Security perimeter fence and gate (rust, compromised, etc.)
- Immediate adjoining environment (houses, veld, farmland, etc.)
- Access road, drainage, slopes, volumes, and areas.

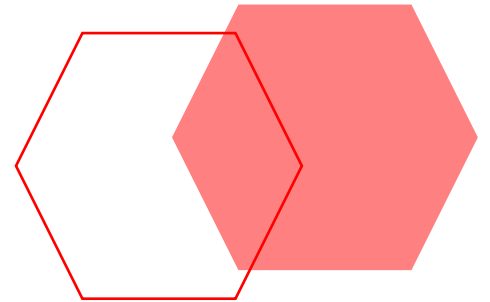
[3D Model Video Link](#)

WEB REPORTING & GIS SITE OVERVIEW



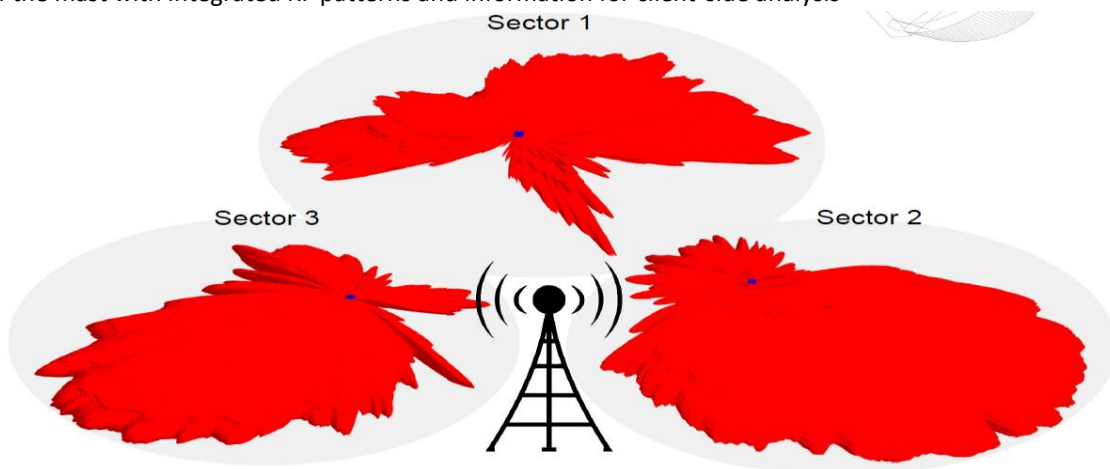


DELIVERABLES



FULL SITE AUDIT DELIVERABLES

- A spectrum scan displaying active channels
- Detailed information of individual channels based on the National Radio Frequency Plan Band Plans (Service Provider frequency, bandwidth, and technology type)
- A display of the radiation pattern of each individual transmitting channel (Vertical pattern, Horizontal pattern, and 3D representation)
- Technical specifications of the channel transmission (Effective Radiated Power (ERP) and bandwidth)
- Highly accurate positioning of individual antennas mounted on the mobile tower/mast
- Antenna characteristics: Centre of Radiation (CoR), Height Above Ground Level, Antenna Width, Antenna Length, Electrical tilt, and Mechanical tilt.
- A list of the channels being transmitted from each individual antenna
- A scaled model of the mast for mechanical and civil analysis
- 3D viewer of the mast with integrated RF patterns and information for client-side analysis



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