



Name

Ms. WEI MEIYING



Presentation  
Title

Application of phase array antenna in NGSO Satellite monitoring  
and Interference



Abstract

Given the emergence of giant NGSO satellite constellations, NGSO satellite monitoring has become a focus and challenge for regulatory authorities. To improve the cost-effectiveness of monitoring equipment, this slide proposes some feasible application methods for phase array antennas in NGSO satellite monitoring and also want to call on the attention of authorities and equipment suppliers to working on this problem together.



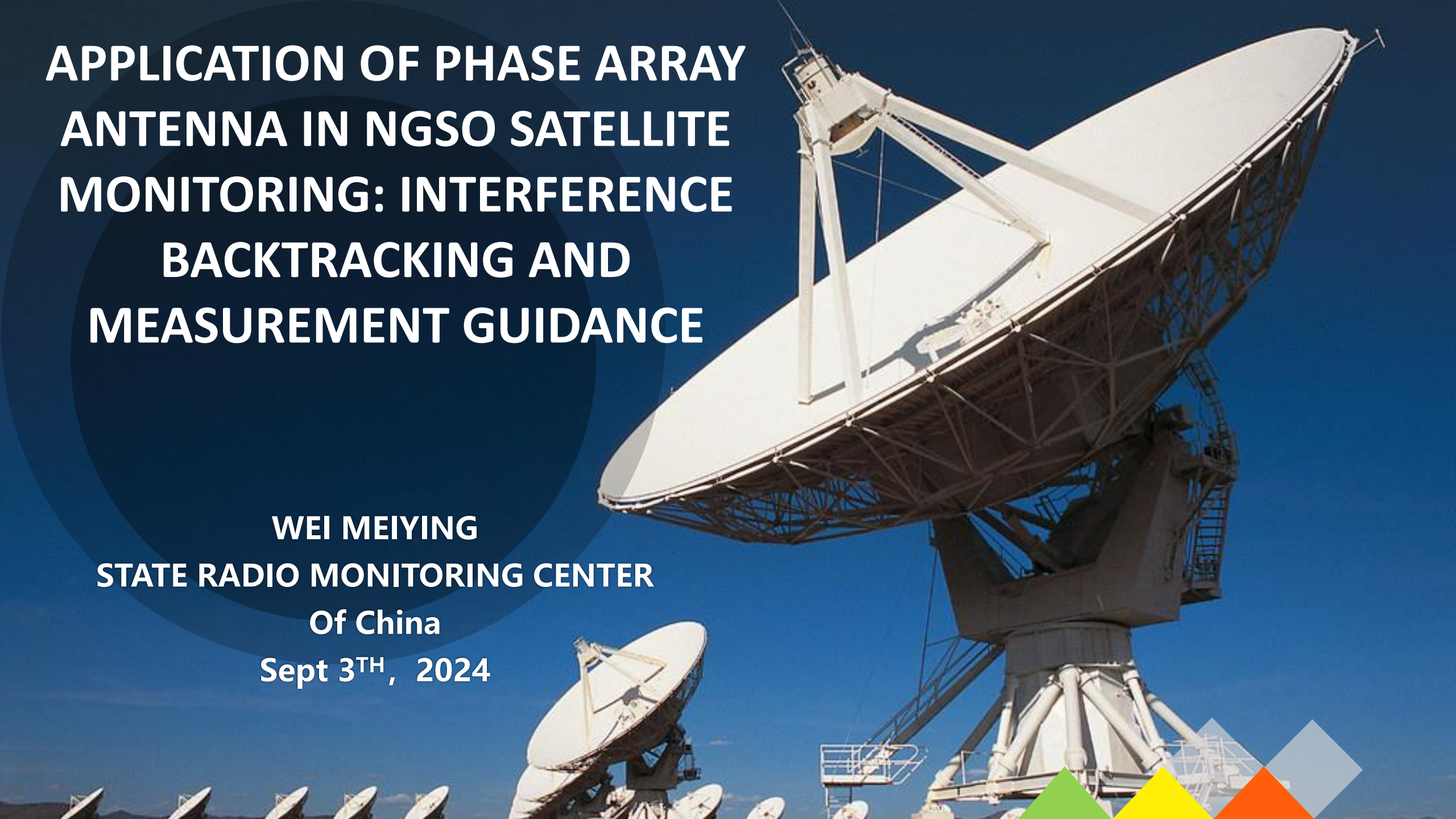
Bio data

Wei Meiyang is a Senior Engineer at the Satellite Monitoring Department of the State Radio Monitoring Center, has been working in the field of satellite monitoring technology and management for 14 years.

# **APPLICATION OF PHASE ARRAY ANTENNA IN NGSO SATELLITE MONITORING: INTERFERENCE BACKTRACKING AND MEASUREMENT GUIDANCE**

**WEI MEIYING  
STATE RADIO MONITORING CENTER  
Of China**

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# 01 | CHANGELLEGES AND REQUIREMENTS



## 01 Challenges on Radio Management and Monitoring

Unbalance between 'available' and 'demanded' resources

➤ **Spectrum resources** : giant constellations share the 'same' bands.

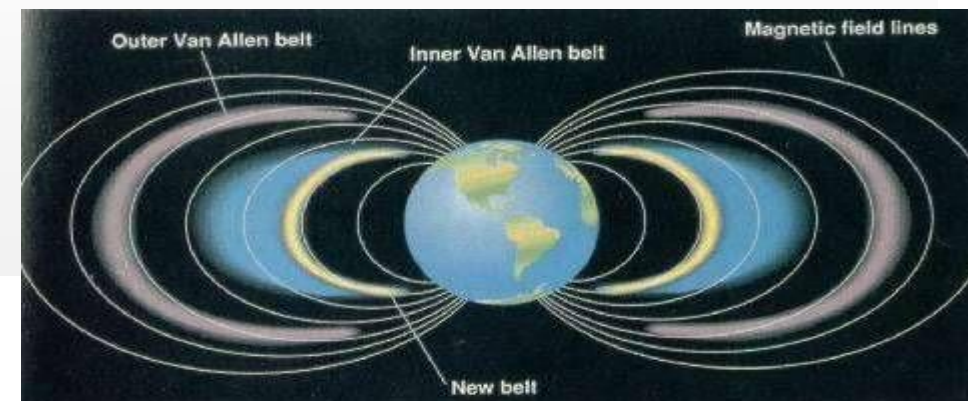
Name of Satellite Constellation	O3b	OneWeb	Starlink	Kuiper	Telesat
Frequency	Ka/V	Ka/Ku/ (V, phase II)	UHF/VHF/L/S/Ku/Ka/QV/E	Ka	Ka

➤ **Orbit resources** : better LEO orbit resources have been seized quickly and the orbits will be crowded

- Consider to Van Allen radiation belts/ atmospheric environment/space debris environment/cost of deorbit, best altitude for LEO is between 500~1400Km.

### Requirment

Measurement function for NGSO links to improve spectrum and orbit efficiency



## 01 | Challenges on Radio Management and Monitoring

Large number of interference complaints may be appealed

### ➤ Interferences to terrestrial and GSO networks 、 between NGSO networks



#### Requirement

Interference detection function to protect the order of resource utilization

**Chapter VI ARTICLE 21 : Terrestrial and space services sharing frequency bands above 1 GHz**

**Section I** Choice of sites and frequencies

**Section III** Power limits for earth stations

**Section V** Limits of power flux-density from space stations

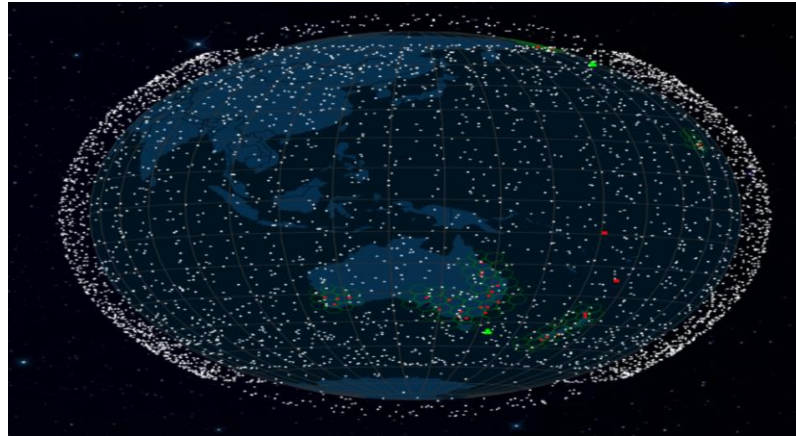
**Chapter VI ARTICLE 22 : Space services**

**Section II Control of interference to geostationary-satellite systems**

-----Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations.

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## 01 | Requirements in NGSO Monitoring



- Monitor large number satellites in LOS simultaneously (or quasi)
- Capture and measure the signals while the transit time is really short
- Good mobility to do the on site monitoring

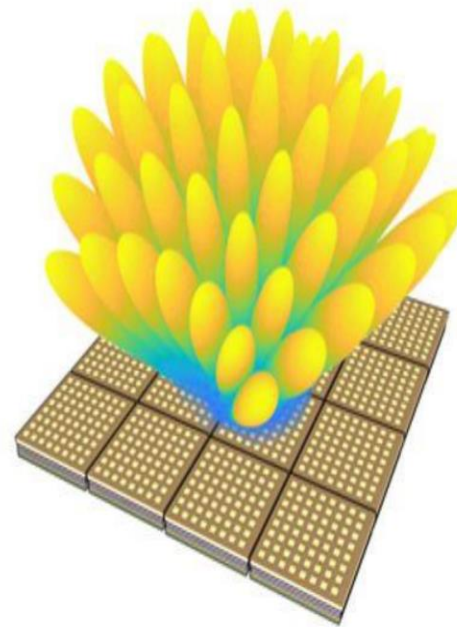
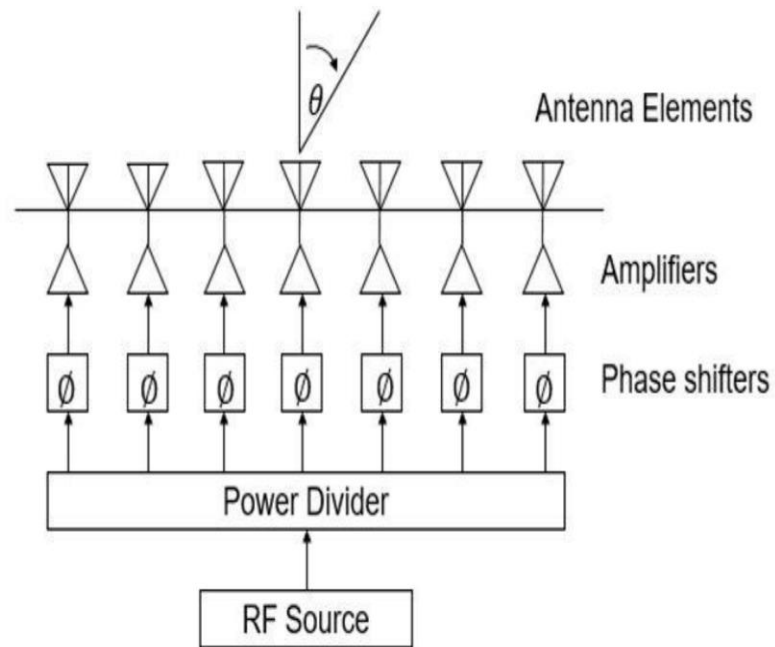
02

## APPLICABILITY ANALYSIS



## 02 | Applicability Analysis

### ➤ How do phase array antennas work



**Quick Beamforming**

**Fast Scanning**

**Multi Beams**

**Conformal to Platform**

**Spatial Filtering and Direction-finding**

**widely used in Radar/Satellite Communication/Emergency Communication/5G...**

## 02 | Applicability Analysis

### Phase array antennas used in NGSO monitoring:

#### ➤ Advantages:

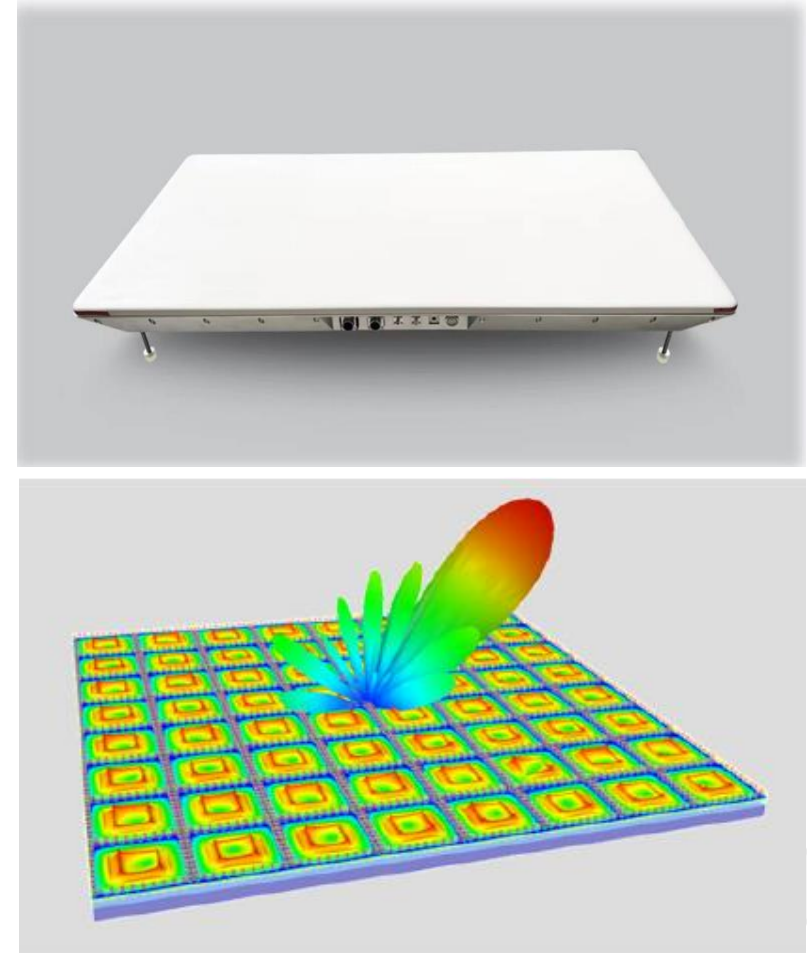
- Can track multi satellites with multi beams (quasi)simultaneously
- Fast switching among multi satellites
- Easier to be portable for on site monitoring

#### ➤ Disadvantages:

- Antenna pattern changes with the elevation
- Narrower LOS scope
- Lower G/T
- Expensive



Supplement, suit for multi-satellite tracking and preliminary measurement



## 02 | Applicability Analysis



### Parabolic antennas used in NGSO monitoring:

#### ➤ Advantages:

- Mature and stable performance
- Wide LOS scope
- High G/T and won't change with the elevation

#### ➤ Disadvantages:

- Can only track one satellite simultaneously
- Need time to switch between satellites
- Poor portability



Suit for accurate measurement

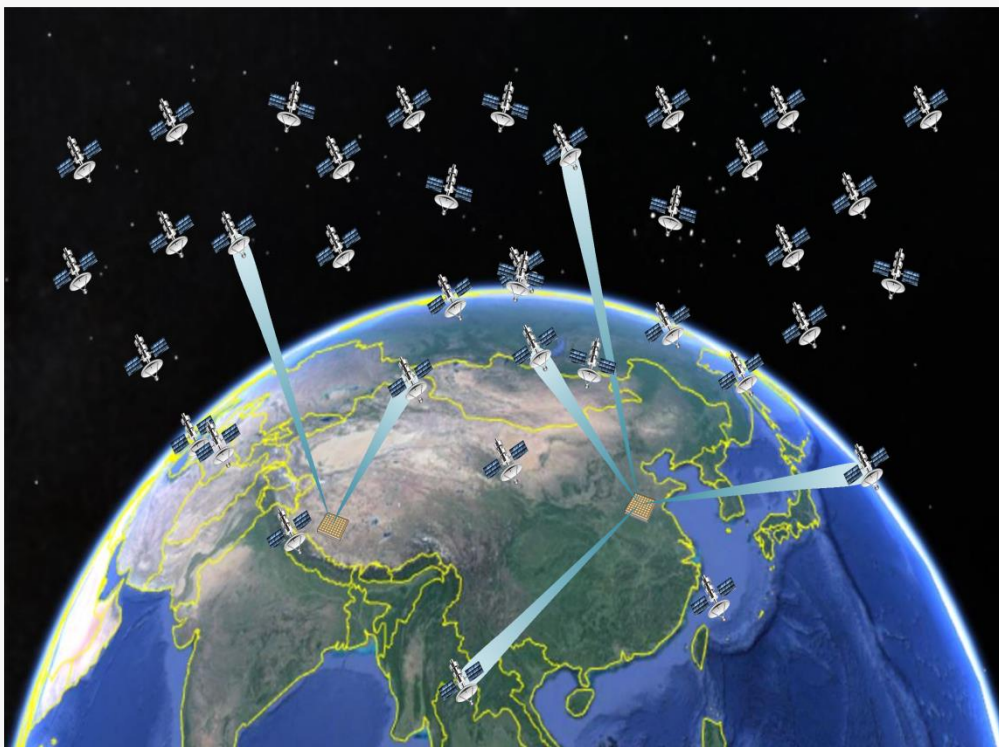
# 03 APPLICATION METHOD PROPOSALS

## 03 | Application Method Proposals: Interference Backtracking



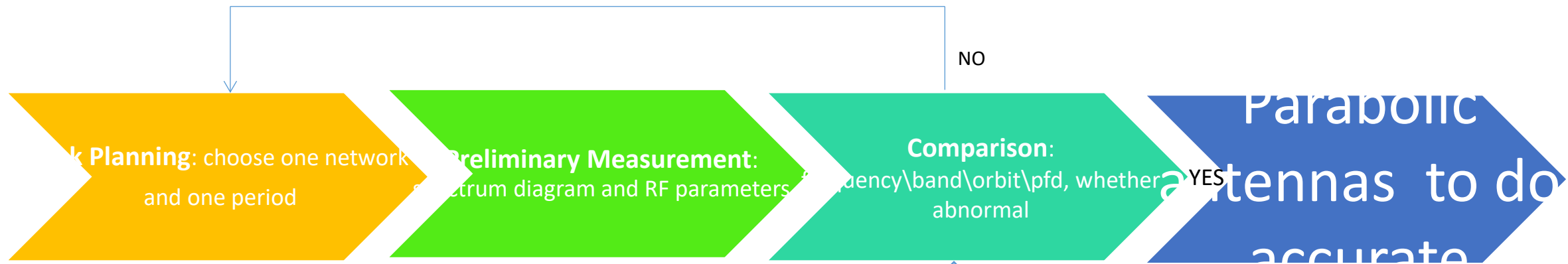
- use phase array system to quick check, parabolic systems to measure

Interference appeals

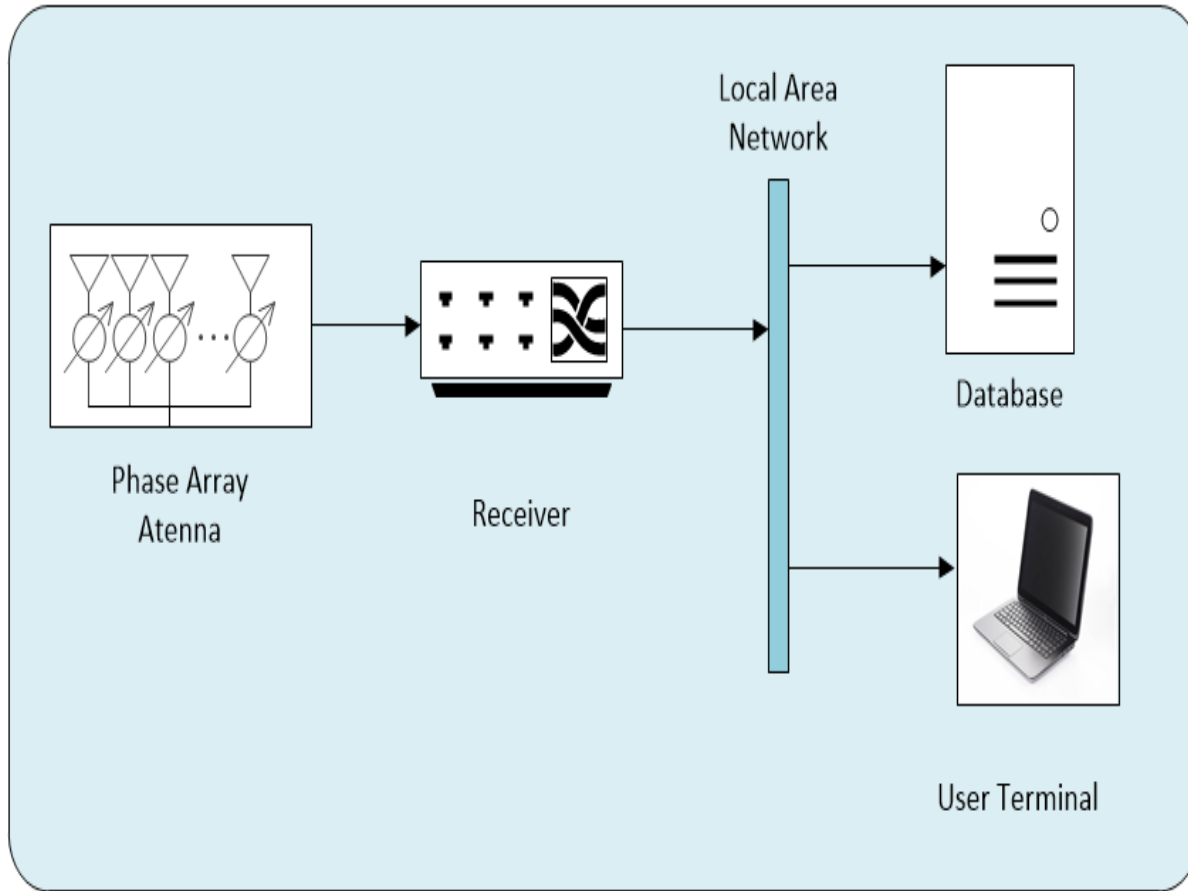




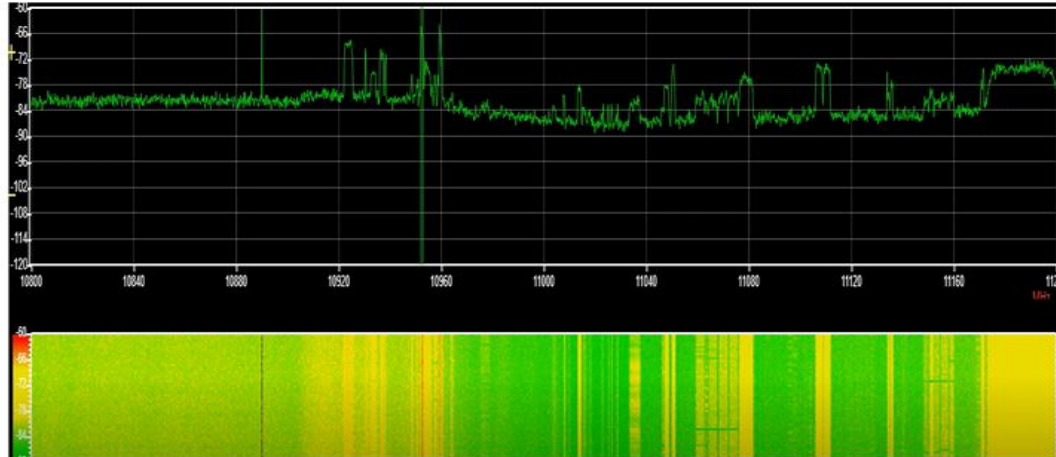
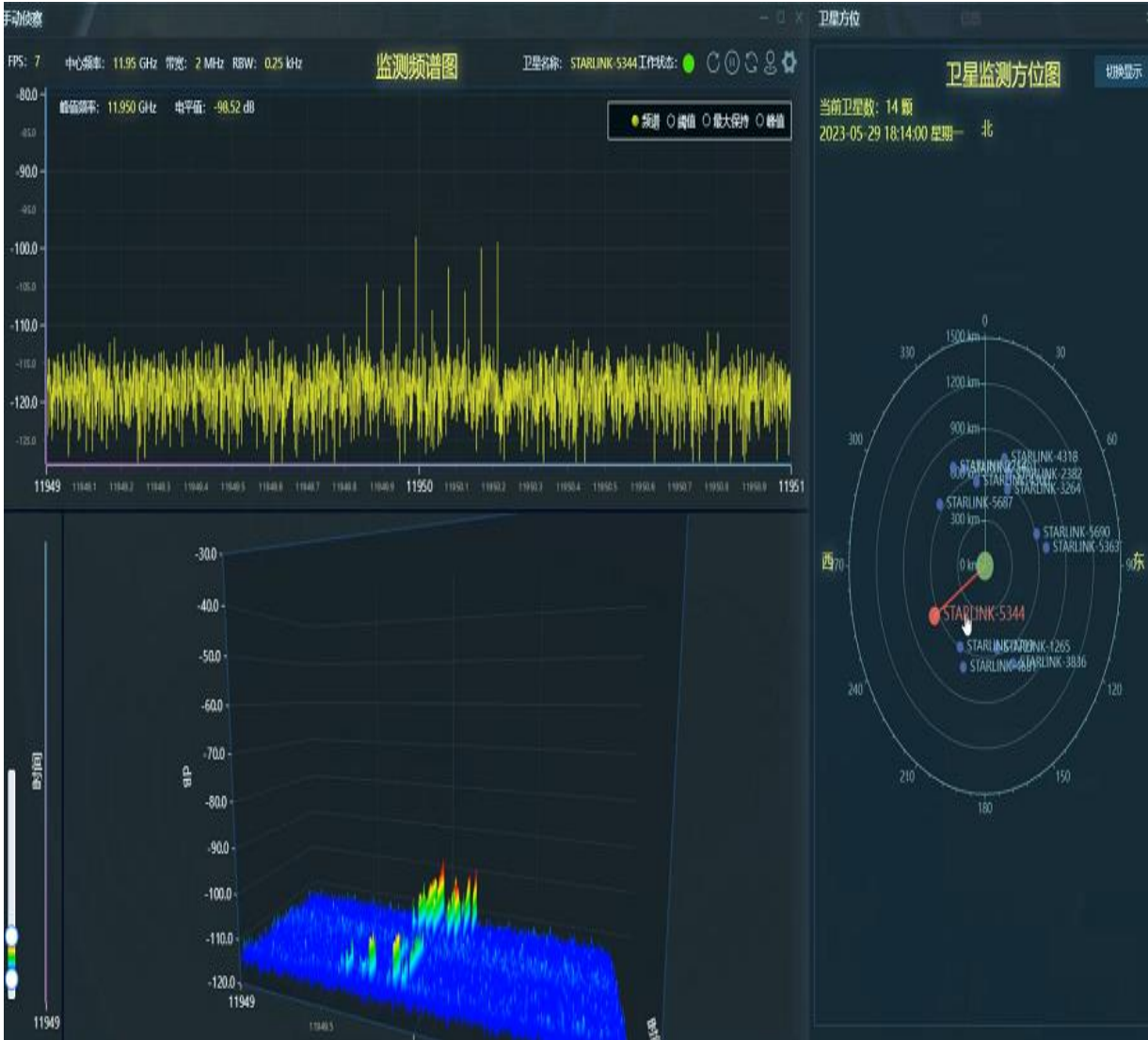
### 03 | Application Method Proposals: Measurement Guidance



## 03 | Application Method Proposals

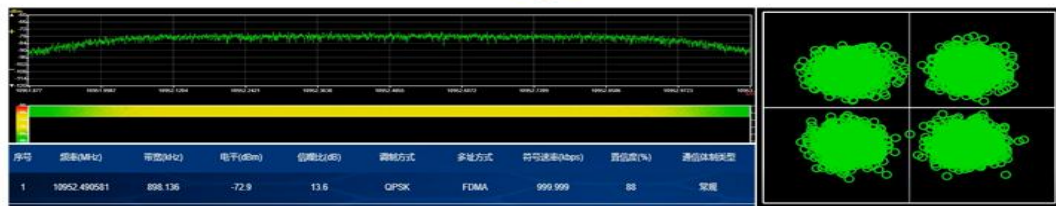


**Experiment System**



序号	载波频率 (M...)	载波带宽(kHz)	载波功率 (d...	通带增益(dB)	载噪比(dB)	PFEDB(mW/m2,Hz)	EIRP(dBm)	多址方式	调制样式	符号速率(kbps)
1	10923.784192	3605.183	-70	0	16	-163.1	64.1	FDMA	QPSK	3000
2	10930.64448	703.869	-72	0	10	-165.1	55	FDMA	未知	-
3	10936.386688	717.83	-72	0	14	-165.1	55.1	FDMA	QPSK	585.142
4	10937.187456	707.72	-72	0	14	-165.1	55.1	FDMA	未知	585.141
5	10938.203136	478.515	-74	0	12	-167.1	51.8	未知	未知	-

序号	测试距离(mHz)	测试带宽(MHz)	测试功率(dBm)	距离(dB)	PRF(dBm/m2 Hz)	ERP(dBm)	全向功率密度(dBW/m2)	多址方式	调制方式	符号速率(kbps)	信号输出频率
4	10037.187456	787.72	-72	14	-165.1	55.1	-33.4	FDMA	8QPSK	585.141	2023-4-12 15:30:34
5	10038.203136	490.367	-74	12	-167.1	51.8	-35.1	FDMA	QPSK	444.395	2023-4-12 15:30:34
6	10042.485376	1217.213	-65	19	-181.1	61.4	-29.5	FDMA	QPSK	1000	2023-4-12 15:30:34



## Analysis

# 04 SUMMARY



- **Phased array antennas will be helpful for NGSO satellites monitoring, an important supplement to the parabolic antenna systems, more work should be done to tap the potentials.**
- **New ITU-R Reports and Recommendations should be proposed to contribute the application methods and for the revision of the Spectrum Monitoring Handbook.**
- **The EPFD measure /location(UL) methods and equipment are still not available, more work should be done to figure out these problems.**



# Q&A

*Wei meiyíng*

State Radio Monitoring  
Center of China

Senior Engineer

[weimeiying@srrc.org.cn](mailto:weimeiying@srrc.org.cn)

# Thanks