Spectrum Sustainability, a Satellite Operator Approach

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BACKGROUND

- 22 Years Operational Experience
- Geographical Coverage within 3 Continents (Europe, M.East and S.Africa)
- Spectrum Management and Monitoring of 3.2GHz (Ku and Ka)
- Number of Transponders : 90
- Spectrum Monitoring System
- Spacecraft Telemetry

RADIO FREQUENCY INTERFERENCE USER CASES

Type-1a: User Defective Operations- (ie Bad Cross Polarization Isolation)

Type-1b: User Defective Operations- (ie Antenna Mispointing (ASI))

Type-2a: Gateway Defective Operations- (ie HPA Intermodulation Noise)

Type-2b: Gateway Defective Operations- (ie HPA ALC Noise)

Type-3: Unauthorized & Malicious transmissions (ie Jamming)

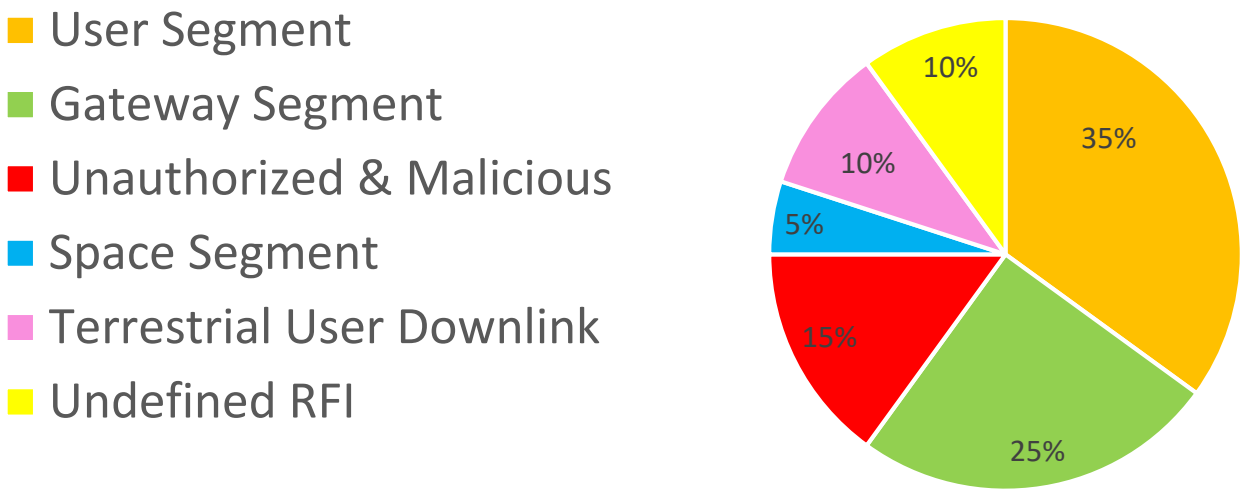
Type-4: Space segment Defective operations – Internal Systems (ie Payload switching, calibration, etc)

Type-5: Space segment Defective operations – External Systems (ie Fly By etc)

Type-6: Terrestrial Interference

Type-7: Uncharacterized source of RFI

RADIO FREQUENCY INTERFERENCE USER CASES– RFI Characterization



- **Factors affecting the RFI characterization:**
  - **Transponders Operational Load & Configuration**
  - **Number of active networks**
  - **Number of Registered & Unregistered Earth Stations**
  - **External Factors**
  - **Seasonal Conditions**

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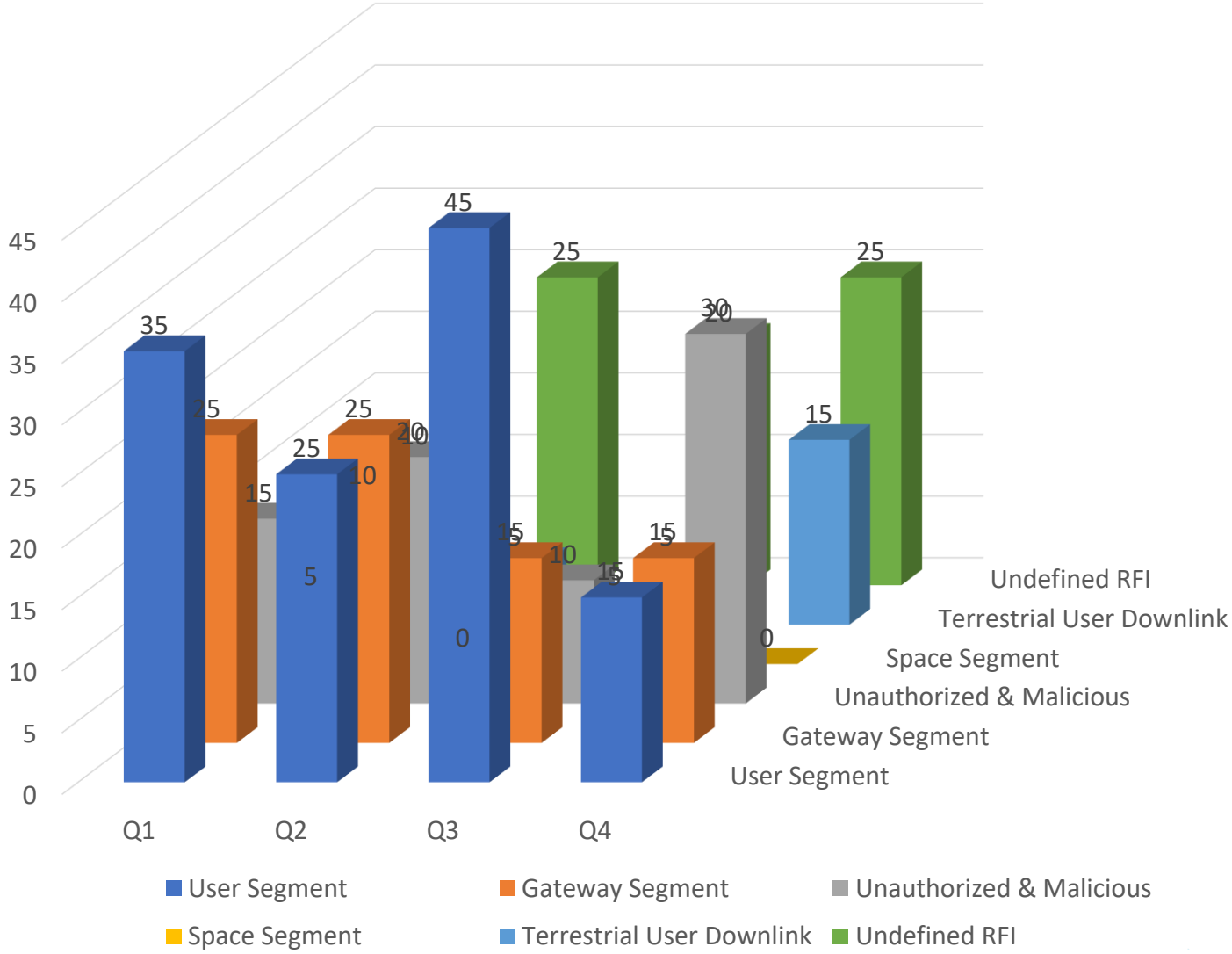

RADIO FREQUENCY INTERFERENCE MANAGEMENT

- Spectrum Monitoring & Telemetry Systems
- Earth Stations Registration, Verification and Testing
- Coordination with the Adjacent Satellite Operators
- Coordination with the Local Regulators
- Interference Geolocation System
- In orbit backup capacity

RADIO FREQUENCY INTERFERENCE EVOLVING CHALLENGES

- Multiple Constellations (GEO,MEO,LEO,VLEO,HEO etc)
- Multiple Frequencies (Terrestrial and Satellite Spectrum Evolution)
- Different Type of Payloads (Transparent, DTP, OBP, etc)
- Multiple Devices (D2D,D2H,etc)
- Different Type of Services (5G/6G-NTN,etc)
- New Protocols and Ecosystems (3GPP,etc)
- Multiple Traffic Profiles (Mobility,etc)
- Dynamic Service Coverage (Mobility,etc)
- Compatibility with Legacy Systems (Waveforms, Access Schemes, etc)

RADIO FREQUENCY INTERFERENCE MANAGEMENT EVOLUTION

- Earth Stations Database, **UNIFIED MANAGEMENT SYSTEM**
- Adjacent Satellite Operators, **UNIFIED MANAGEMENT SYSTEM**
- Local Regulators,
- Interference Geolocation System, **UNIFIED MANAGEMENT SYSTEM (Space & Ground)**
- Spectrum Monitoring Systems **(Next Generation-SDR and AI)**
- Automated Alarms Notification System, **AI (Preventive RFI Detection)**
- Automated RFI Recovery System, **AI (RFI Mitigation)**
- Interference Mitigation Techniques, **User Domain (SDR and AI)**

Thank you