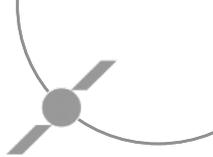


Mark RAWLINS – Eutelsat
Director of Service Operations

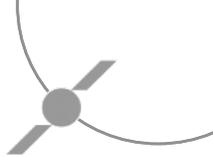
ASBU Satellite Interference Forum The Satellite Operator Role

Tunis 6th – 7th October 2013

Eutelsat mission objectives

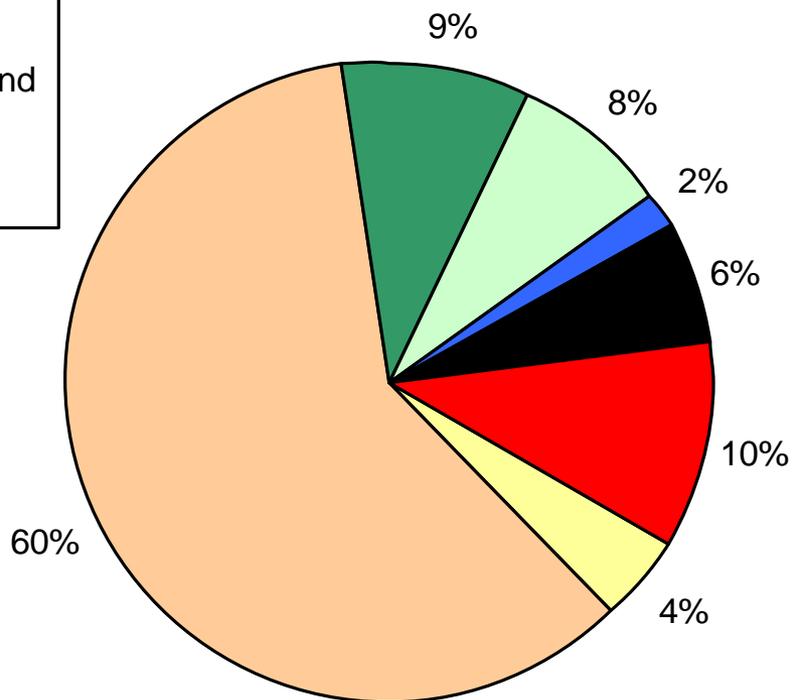
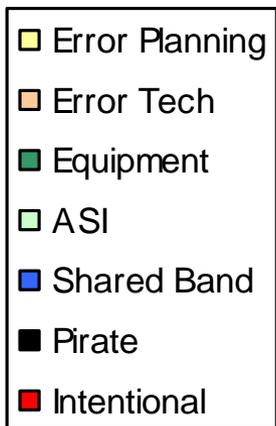
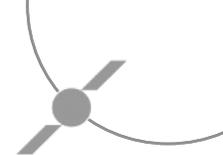


- Our mission is to provide our clients the **satellite infrastructure adapted to their needs**
 - It means **High Performance, High Availability, High Reliability and Sustainability**
- These needs evolve with time according to market evolution, technology, competition, regulation and geo-political environment
- Satellite operators maintain a **high investment ratio** to develop satellites and ground networks that can best provide space systems to meet these requirements
- RF interference is the single largest factor affecting service quality of satellite services.



- Ensure the service continuity, availability and quality of the satellite capacity commercialised by Eutelsat
- Assure support to customers and users for accessing the satellite capacity and resolving any related problems
- Assure the availability of a monitoring network and monitoring systems that allows the best possible availability of the tools necessary to analyse problems affecting any customer service on any part of the satellite fleet

Interference to Satellite Services



Accidental Sources

- Human Error
- Adjacent Satellite
- Equipment failure

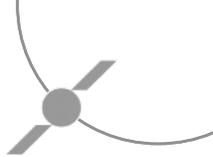
Deliberate Sources

- Jamming
- Pirating

Other Sources (Shared bands)

- Radar
- Wimax

The most Common Causes of Interference



- **Human Error**

- Wrong time slot
- Wrong Satellite
- Wrong frequency
- Wrong or bad polarisation setting
- Incorrectly pointed antenna

- **Faulty equipment or cabling**

- **Poor Quality ground systems**

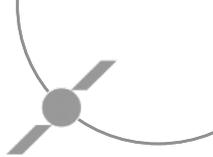
- Poor antenna specifications – overspill into other adjacent satellites
- Lots more equipment out there – raising the probability of problems
- Pressure to lower manufacturing costs – maybe less reliable
- New technologies and functions – eg Autodeploy systems



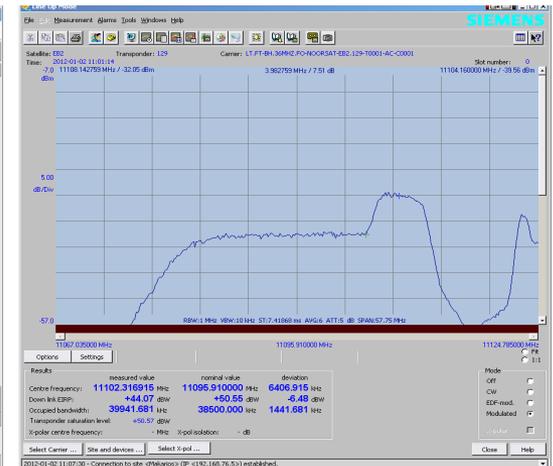
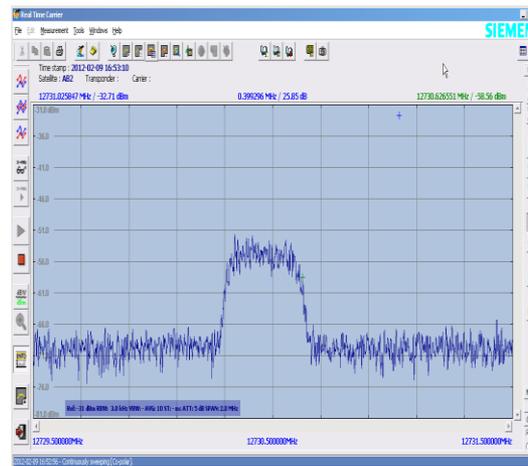
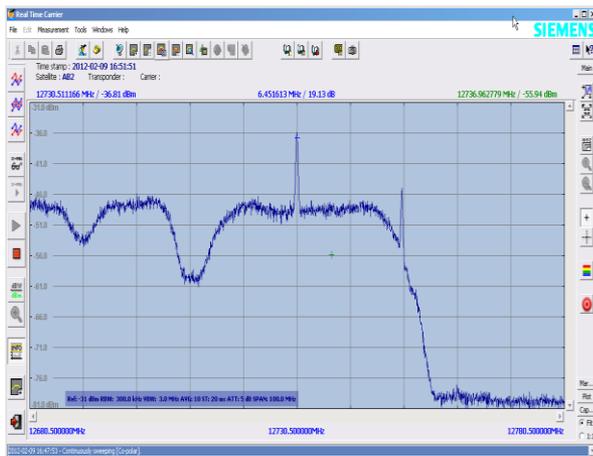
“Now where’s that 500Watt HPA I had?”

More satellites, less orbital spacing require respecting tighter technical specifications

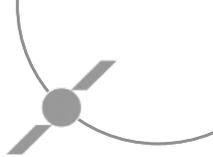
Reducing Interference



- Antenna type approvals and ESVA testing
- Training Programs
- Communication
- Statistical analysis - identification of problem areas
- SDA – A means of rapidly sharing information with other satellite operators
- Carrier ID – Adopted as DVB standard Feb 2013, ETSI in May 2013.



When Interference is deliberate



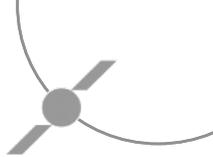
Pirating - A growing problem

- **Unauthorised use of satellite capacity**
 - Causes disruption to legitimate services

Deliberate signal Jamming

- **Interfering signal characteristics**
 - Clean Carrier or Empty modulated carrier
 - Frequency of interfering carrier
- **Content or Origin of target carrier**
 - Contains politically sensitive channel(s)
 - Audio Language or target audience of channels
- **Aggravating Circumstances**
 - Political situations
 - Social unrest and demonstrations
- **Changing parameters**
 - Are changes to the target carrier tracked by the interfering carrier?
 - Do changes to the content of the target carrier result in removal of the jamming carrier?

Pirating satellite capacity



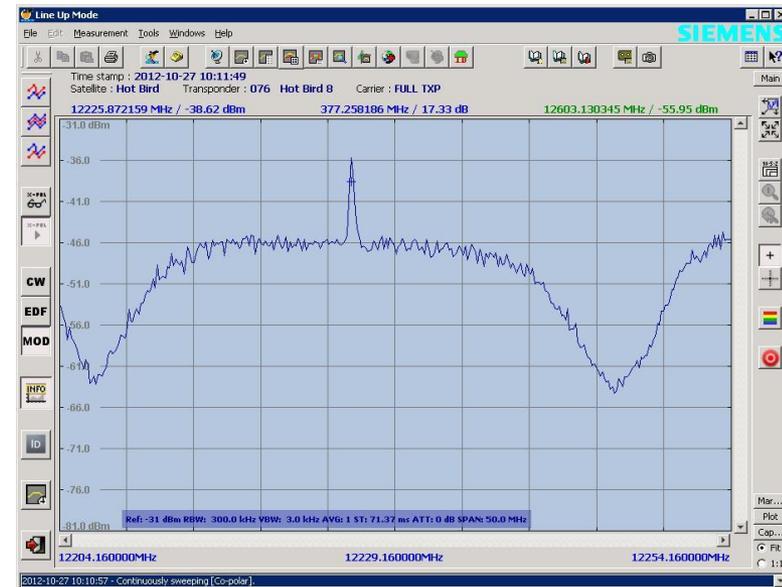
- **Increasing notably in the last two years**
- **Short duration transmissions – always television**
- **Pirates intention is to make an unnoticed transmission – However**
 - The transmission “steals” power from the transponder and lower quality of legitimate services
 - Often is put over “Invisible” TDMA networks causing service interruption
- **Pirates often think they are making a legitimate transmission having paid an illegal entity posing as a satellite capacity reseller**
- **Often are contribution feeds for news services or other satellite TV channels.**
- **Geolocalised and recorded as often as possible.**

Intentional Interference (often referred to as “Jamming”)

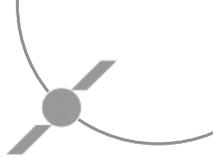
- Blocking the transmission of legitimate satellite services
- Politically motivated
- Targets news channels such as BBC, VOA, France 24, Deutsche Welle
- Other channels affected by collateral damage
- Government and broadcaster support is being demonstrated and is showing effects.

Some Figures

- 2010 – 54 cases
- 2011 – 109 cases
- 2012 – 552 cases
- 2013 – 155 (to date)
- October 2012 - 70% of interference targeted BBC World and VOA

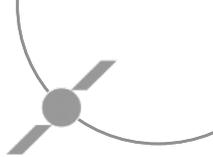


Overcoming the Intentional Interference



- **Reducing sensitivity of satellite and increasing the power of the legitimate transmission**
- **Change of uplink coverage, if available**
- **Provision of alternative capacity if appropriate or possible**
- **Dialogue with customer to identify potential target services**
- **High power anti-jamming antennas**

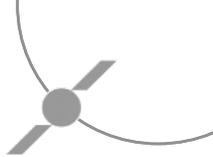
Eutelsat Monitoring and control systems



- **Radio Frequency Monitoring – Siecams from Siemens Austria deployed in multiple sites:**
 - Rambouillet, Sardinia, Cyprus, Moscow, New York, Sao Paulo, Youandé, Johannesburg, Dubai, Ile Maurice, Madagascar, Japan, Nouvel Caledonie
- **DVB Monitoring System for DVBs and S2 broadcast services:**
 - Rambouillet, Paris, Cyprus, Johannesburg, Yaoundé, Ile Maurice
- **Geolocalisation Systems – Siecams and SatID**
 - Rambouillet, Cyprus (Johannesburg and Dubai being deployed).
- **Video Recording – to allow reception and recording of DVBs and DVBs2 broadcast services for content control**
 - Cyprus, Dubai and Johannesburg

Eutelsat objective: to monitor and control all satellite capacity and communications services commercialised by Eutelsat in all regions serviced by our satellites.

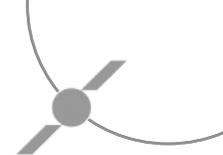
Eutelsat use of Geolocalisation Systems



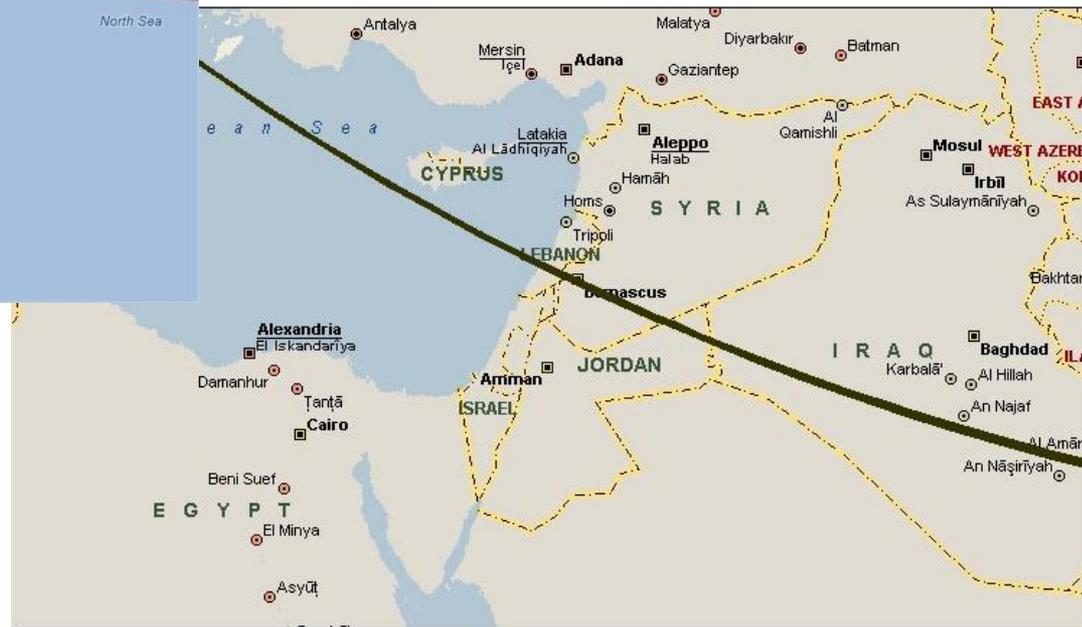
- From 1995 Geolocalisation Service DERA/UK Ministry of Defence
- 2000 Procurement of a geolocalisation system to protect European coverages
- 2004 Expansion of geolocalisation facilities to protect Middle Eastern coverages
- 2004 Enable cross site working of geolocalisation scenarios
- 2006 Development of techniques to handle sweeping carriers
- 2007 Increasing antenna connectivity to include multiple band
- 2013 Integration of geolocalisation system into Radio Frequency monitoring system
- 2014 Expansion of the system to cover South Africa and Dubai

Eutelsat continues to invest in the latest and best technology to help combat interference problems.

Comparison of two types of situation

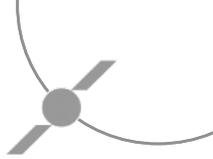


Fast and accurate, the signal is modulated



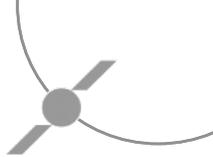
More samples required to produce result – a series of measurements are required – a sinusoidal (CW) interference

Improving Precision



- **Making multiple measurements**
- **Making measurements to correct satellite position and velocity errors**
- **Modifying periodical manoeuvres to increase the rate of change between satellites**

Future Technical Trends - Geolocation



- **Faster**

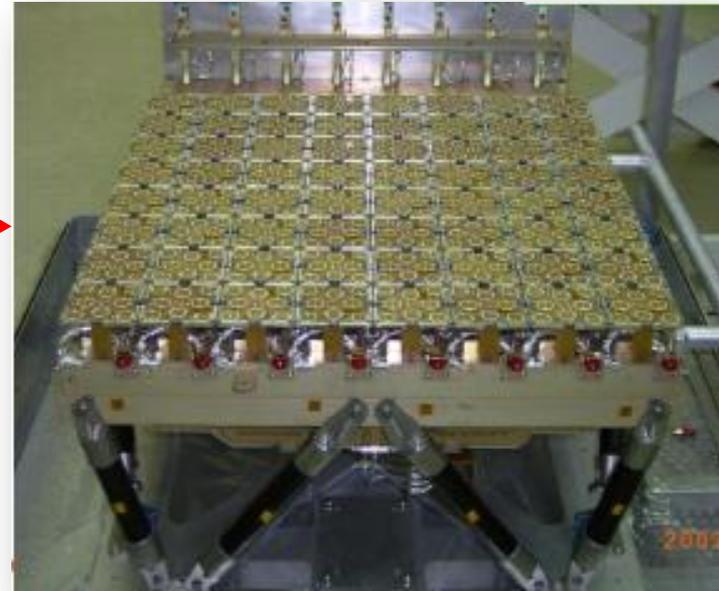
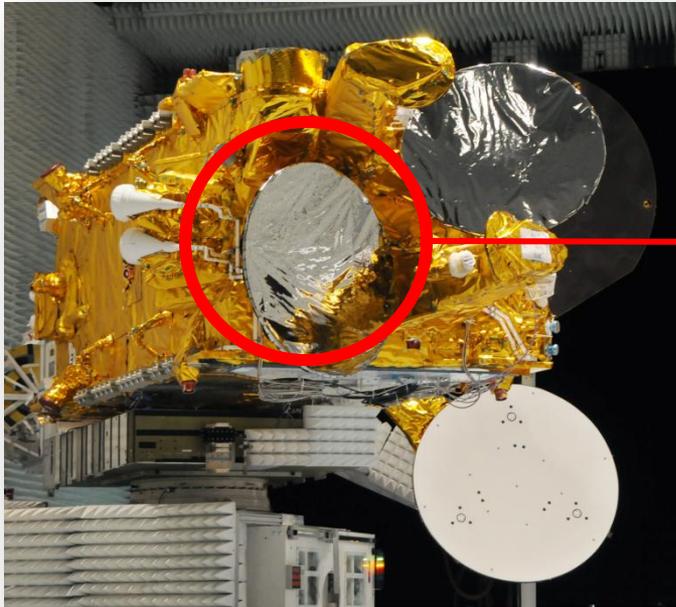
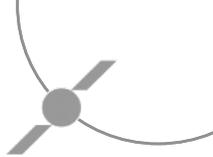
- Pre-setting of ground-based geolocation of equipment
- Exchange of data between satellite operators

- **Independent**

- Geolocation is done today by triangulation between adjacent satellites (the victim satellite and one adjacent satellite)
- Tomorrow will be done independently on board the satellite, or using a single satellite

- **More accurate**

- Geolocation accuracy by triangulation depends on angular separation between satellites and satellite ephemeris accuracy
- Better reference sources



Mechanical reflector antennas

- beam shape is fixed
- jamming direction detection achieved separately
- isolation from jamming is provided beam pointing mechanically away from the jamming direction(s)

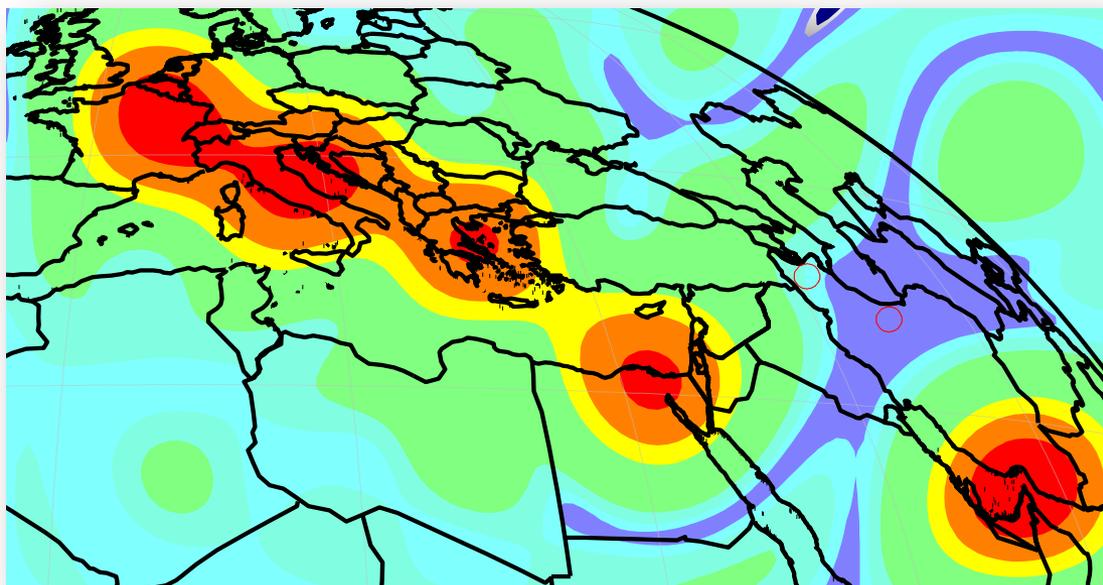
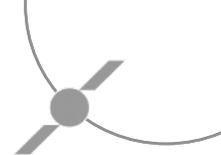
TODAY

Active antenna (Earth deck)

- beam shaping electronically
- shaping of useful receiving zones
- also used for jamming direction detection
- shaping of receiving beam for exclusion zones

TOMORROW

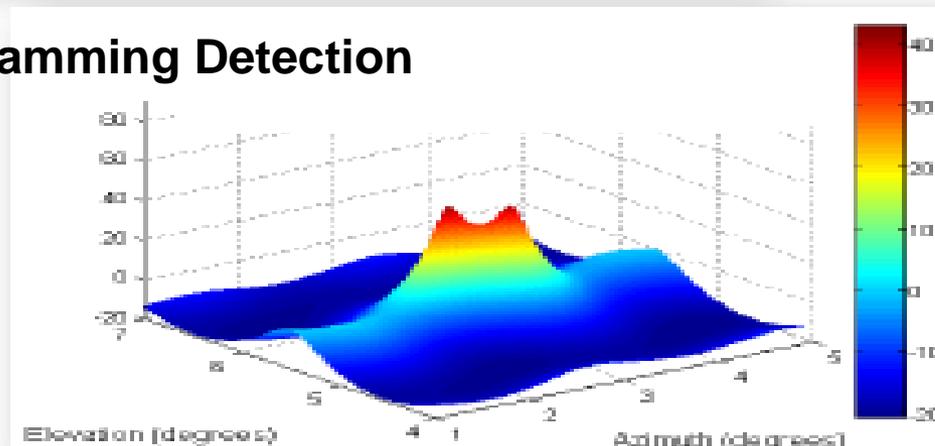
Jamming location detection and isolation



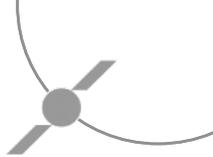
Jamming Isolation

Example simulation:
Active antenna providing 5 uplink zones and isolating Tabriz and Tehran after jamming location detection

Jamming Detection

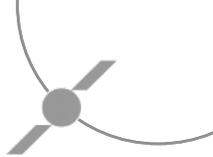


Future Technical Trends - Conclusion



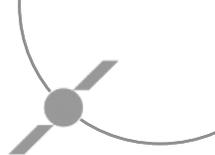
- **Other counter-measures can also be devised, such as agility in uplink frequency for a given downlink broadcast frequency:**
 - Implemented with new generation agile down-converters **on our next E8WB satellite** procured from Thales Alenia Space, with support from ESA and CNES
 - Can be applied to TCR sub-systems for increased resilience and operational flexibility.
Will be implemented on E8WB
 - Technique can be generalized further with a pool of frequencies to create evasive feeder links for broadcast content
- **Home receive equipment, but more difficult to implement**
 - Design of new, more resilient access schemes and radiofrequency waveforms
 - Need for a standard to be accepted, approved and wide scale equipment roll-out
- **Techniques can be devised and teams can be trained, but a global action plan and coordination between all concerned are key to limit and possibly stop what is a pollution of the natural resource of spectrum**

Parallel Actions for addressing Deliberate Interference problems



- **Engaging National Regulators**
- **Engaging Governments**
- **Engaging ITU**
- **Support from the Broadcast community**
- **Naming offenders and publishing information into the public domain.**
- **Coordination activities with other Satellite Operators and the satellite industry.**

SDA – Space Data Association Operational Coordination



- **SDA Executive Members:**



- **Technology Adviser / SDC Operator:**

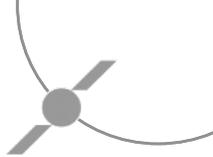


- **Space Data Center:**

- Verified, normalized data
- Fully automated operations backed by experts 24/7

- **Open to all satellite operators in all orbits**

- **Strong legal agreement protect all participants from disclosure / misuse**



- **Increase safety of flight**
 - Automatic conjunction assessment
 - Includes planned maneuvers
- **Deal with the growing problem of RFI**
 - RFI Alerts to focused distribution
 - RFI historical event search
 - Generation of geolocation data sets
 - Carrier ID database
- **Enable more efficient operations for all**
 - Reliable contacts database for satellite operators – technical and operations personnel