INTERFERENCE MITIGATION IN SATELLITE COMMUNICATIONS

AVIO-601

ABSTRACT

1. **Development** of **Interference mitigation** technologies for Next-Generation Satellite Communications
2. **Investigation** of novel cognitive systems architectures and advanced digital signal processing techniques
3. **Demonstration** of advanced proof-of-concept Hardware/Software prototypes to mitigate Interference events in **Satellite Communications (SatCom)**
4. To provide **management tools** and **anti-jamming techniques** to aerospace industry

PROJECT DETAILS

Project Title:
Interference Mitigation in Satellite Communications

Project Code:
AVIO-601

Project Start Date:
1st October 2014

Project End Date:
30th September 2018

Project Duration:
4 Years

RESEARCH PROBLEMS

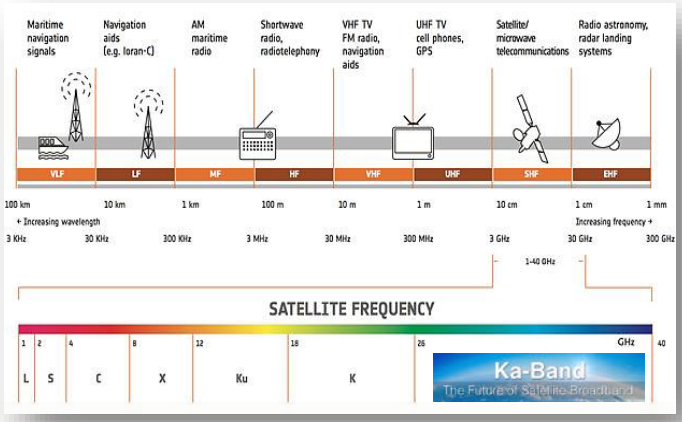
Context of SatCom spectrum and limitations:

1 - Near-congestion of satellite communication bands (L / S / C / Ku)
There is a steady growth of deployed services and new applications

2 - Scarcity of Radio Frequency (RF) spectrum
The congestion of conventional frequency bands is a major barrier to the deployment of new services

3 - Increase of Interference events: more and more complex with severe impacts
Radio Frequency Interference continues to degrade transmissions and disrupt the SatCom industry

4 - Issues on Ka-band
Designed to bring new capacities and supplement SatCom bands, this band has not been widely adopted by operators due to its cost and susceptibility from rain and other weather conditions



Urgent Need! Tackle **man-made** interference due to :

● *Human error* ● *Improper installation* ● *Lack of training* ● *Poor or sub-standard equipment* ● *Equipment failure* ● *Lack of adherence to regulatory requirements and industry standards* ● *Poor system design* ● *Adjacent/Nearby systems* ● *Terrestrial interferers* ● *Orbital interferers* ● *RF jammers* ● *Malicious interference* ● *Spoofing attacks*

OBJECTIVES

1)	**DETECT**	Detect the presence of interference and identify all sources
2)	**CHARACTERIZE**	Recognize, measure and classify interference signal signatures
3)	**LOCATE**	Determine the interference position, orientation and affected areas
4)	**MITIGATE**	Remove the interference in real-time, or at least reduce its effects
5)	**MONITOR**	Build an Atlas database for spectrum management allowing real-time effective interference counter-measures

To ensure in real-time and for all SatCom bands:

1) Robustness 2) Reliability 3) Integrity 4) Quality of Service (QoS)
5) Continuity 6) Availability 7) Accuracy 8) Quality of Experience (QoE)

RESEARCH FIELDS

Aerospace Engineering
Signal Processing
Navigation
Antenna Design
Hardware In the Loop
Satellite Technologies
Digital Communications
Microelectronics
Electromagnetic Interference

PROJECT WORK PLAN

Phase 1 - Research process (2014-2015)
1) Technological reviews 2) Problematic studies
3) Requirements definition 4) Selection of techniques

Phase 2 - Development process (2015-2016)
1) Algorithmic design 2) SW Initial implementation
3) Initial simulations 4) SW Performance evaluation

Phase 3 - Integration process (2016-2017)
1) SW-HW specifications 2) Integration on HW platform
3) Interference scenarios 4) Laboratory and in-field tests

Phase 4 - Demonstration process (2017-2018)
1) HW optimization 2) In-field demonstrations
3) Prototypes validation 4) Deliverables and final reports

*SW : software * HW : hardware

PROJECT SCOPE

1) Characterization of SatCom Interference environment and effects
2) Development of practical models based on fundamental and state-of-the-art theories
3) Simulation, analysis and demonstration of the five AVIO-601 goals and associated modules
4) Implementation of a full-duplex SatCom emulator testbed and interference scenarios
5) Integration of developed modules on SDR platforms
6) Performance analysis of the integrated prototypes in SatCom Emulator and real testing environment
7) Validation and technology transfer to our industrial partners

PROJECT BENEFITS

1) To provide tools to detect, characterize, locate, mitigate and monitor interference
2) To deliver a transmission with a performant and consistent Quality of Service (QoS)
3) To improve end-users' Quality of Experience (QoE)
4) To enable regulators to easily manage spectrum requirements
5) To establish a productive international collaboration between countries (legal vs technology)
6) To stimulate economy and influence establishment of R&D centers and enterprises
7) To train future space community leaders and provide Highly Qualified Personnel (HQP) to industry
8) To enhance collective knowledge through improved education and advanced training
9) To engage stakeholders investigating satellite communications issues (interference, space security and sustainability) through technical, socio-economic and legal aspects

EVERYONE IS BENEFITING:

Operators, manufacturers, broadcasters, regulators, officials, institutions, scientists, academia and end-users

WORLD UNIQUE LABORATORY SATCOM LINK EMULATOR

- ***UNIQUE LABORATORY FULL-DUPLEX SATCOM LINK EMULATOR :***
  Simulate in real-time a complete satellite network enabling advanced complex interference scenarios using Software-defined radios (SDR) and powerful satellite channel emulator
- ***RT LOGIC T400CS :***
  World-class channel emulator featuring IF and RF hardware-in-the-loop (HIL) tests: flight and ground system testing, interference and reference signal generation, compliance and performance loop-back testing, training capabilities
- ***BEECUBE BEE4 SDR PLATFORM:***
  Full-speed prototyping platform serving as a complete "Satellite Emulator" enabling real-time implementation and emulation of Satellite transponder functionalities
- ***NUTAQ SDR SOLUTIONS:***
  Featuring digital signal processing to enable the development and integration of AVIO-601 techniques developed by researchers (detection, characterization, geolocation, mitigation, spectrum monitoring)

AVIO-601 Space modules
Nutaq PicoSDR

AVIO-601 terrestrial modules
Nutaq ZeptoSDR

AVIO-601 Channel Emulator
RT Logic T400CS

AVIO-601 Satellite Emulator
BEECube BEE4 SDR

SENIOR RESEARCHERS

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