

# Maximising Radio Resource Flexibility and Resilience

Initial results suggest Inmarsat will experience an efficiency boost of 20 to 40% in the most congested geographical areas.



Inmarsat is the world leader in global mobile satellite communications, with the world's most advanced and resilient mobile connectivity infrastructure, to ensure that its satellite services are not only saving lives but also providing a connectivity lifeline in the most remote and challenging locations.

**Industry:** Communications  
**Location:** International  
**Use Cases:** Bandwidth Optimization  
**Website:** [www.inmarsat.com](http://www.inmarsat.com)

## Results

- Up to 40% increase in efficiency
- Significant improvement in resource utilisation and end-customer satisfaction

As the world leader in global, mobile satellite communications, Inmarsat customers include governments and aid agencies, as well as the maritime, aviation, agriculture, and mining industries among others.

Rapid growth in demand for their services prompted Inmarsat to seek an optimisation partner, to ensure their satellites remain operating at peak capacity. Inmarsat turned to Gurobi Alliance Partner Smith Institute for help. Smith Institute's expertise in algorithm design and mathematical optimisation—combined with their particular knowledge of the complexities of radio communications spectrum management—made them an attractive choice.

## Addressing massive complexities

Smith Institute worked with Inmarsat to construct and benchmark an optimised series of algorithms that maximise spare capacity responsively and minimise unmet demand—enhancing the customer experience and protecting Inmarsat's bottom line.

Smith Institute worked closely with Inmarsat's radio resources management team to understand fully the current operating methods and the challenges they faced. Once they had gained a good grounding in the specifics of Inmarsat's operations, they set about creating a model of the existing system against which they would be able to benchmark new methodologies. This would ensure they could prove the value of any proposed solution.

With an agreed model of the existing radio resource management system in place, the Smith Institute team was able to begin to break down the end-to-end system into its constituent parts—looking in-depth at which mathematical techniques might be applied to enhance their flexibility and resilience.

Effective radio resource management for satellite communications must address multiple complexities:

- How the specific capabilities of each device communicating with the satellite network are affected by a complex interplay of factors—including symbol rates, modulation options, error checking and correction, energy consumption, and atmospheric conditions.

## Smith institute

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Smith Institute offers organisations the agility they need today to make strategic decisions rapidly and with certainty. It investigates core processes to capture crucial data, analyse the data itself, and acquire an in-depth understanding of key business objectives.

Its expertise in modelling, algorithms design, and analysing complex real-world scenarios enables its clients to maintain commercial advantage and make decisions with confidence.

Learn more at [smithinst.co.uk](http://smithinst.co.uk)



**“Gurobi is consistently the right tool for robust, high-powered optimisation at speed.”**

**Charles Choyce**

*Business Development Manager –  
Spectrum, Smith Institute*



- Each of Inmarsat’s satellites needs to be able to offer a set of characteristics that will allow the smoothest experience possible for all devices requesting its services under the prevailing conditions.
- At the same time, they also need to have the flexibility to adjust those characteristics if conditions or capabilities change.
- In addition, the operation of Inmarsat’s service needs to be in compliance with its legal, regulatory, and contractual obligations.

To manage this complexity, Smith Institute took a two-stage approach. First, they constructed a genetic algorithm programmed to assemble and analyse a set of likely transmission scenarios. From here, they could determine a combination of traffic carriers favourable to meet anticipated demand in the prevailing conditions.

These optimal traffic carrier combinations could then be fed into the second stage algorithm, which creates the bandwidth bundles best suited to meet current, recognised demand. To create these bandwidth bundles, this second-stage algorithm, processed by Gurobi Optimizer, matches selected symbol rates to appropriate modulation and error correction options—as determined by the capabilities of the devices currently transmitting to the satellites and the prevailing atmospheric conditions.

Finally, the Gurobi Optimizer processes the algorithm again to assign these bandwidth bundles to the specific devices, so that all devices get the optimal connection experience given their characteristics, the overall traffic, the prevailing conditions as they affect each device, and Inmarsat’s service obligations.

### **Gurobi delivers the boost of solving speed and power Inmarsat needed**

Even when the model is expertly crafted, solving the complex real-world mathematical model Smith Institute created for Inmarsat’s radio resources management problem is only feasible with specialist software. Smith Institute

**“Gurobi is ideally suited for this project, with its ability to handle complex real-world constraints and outcomes.”**

**Dr. Robert Leese**

*Chief Technical Officer, Smith Institute*

has found that the Gurobi Optimizer is consistently the right tool for robust, high-powered optimisation at speed, and it was ideally suited to processing their

radio resource management model, with its multitude of constraints and possible outcomes.

The solution is expected to allow Inmarsat to identify satellite beams with underperforming bandwidth bundles and optimise and reconfigure these to increase utilisation efficiency. Initial results suggest that this will allow an increase in efficiency of 20 to 40% in the most congested geographical areas. Considering the scarcity of satellite resources, this represents a significant improvement in resource utilisation and end-customer satisfaction.

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