ANASTASIA
Airborne New Advanced Satellite Techniques and Technologies in A System Integrated Approach

Capacity Analysis and Revenue Estimation.

Lead contractor for this deliverable: TGS.

Executive Summary

This document addresses the capacity analysis and the estimation of revenues and costs associated with the services provided by a global satellite-based system (“the Anastasia system”), considering both segments of passenger and cockpit communications.

Section 3 provides an overview of the general capacity dimensioning method used for global aeronautical communications systems. The approach and its elements as presented in this section, are used with respective adaptations for both later segments of Aeronautical Passenger Communications (APC) and Air Traffic Management (ATM) Communications.

The major steps for capacity dimensioning are
1. the determination of global flights by time and location, based on a global flight database and proper cruising and geographic route models;
2. the identification of serving satellite(s) and their coverage areas (footprints and spot beams) for the respective candidate constellation;
3. the mapping and accumulation of flights/aircrafts onto footprints and spot beams;
4. the determination of the asymmetric gross traffic (up- and downlink) per aircraft and subsequently per satellite footprint, which varies over time and location.

From the latter, the important worst case situation can be extracted which is a key input to the iterative constellation and system design process and basically determines the required capacity which the satellites (one, some or all – depending on the considered constellation) should provide to provide acceptable QoS and meet the addressable market.

All numerical investigations can be performed with arbitrary resolution in a proprietary and dedicated simulation tool. The models and algorithms used are all scalable and parametric and can thus be extended and adapted, so that the approach as well as the tool is future-proof.

Section 4 addresses the capacity analysis and revenue estimation for the aeronautical passenger communications (APC) segment of Anastasia, where we restrict to the three services voice, email, and web browsing.

Based on a detailed modelling of aircraft and service categories as well as flight categories and phases, extensive numerical results are derived for
- number of flights and passenger flight hours (PFH), which can be broken down into all mentioned categories and on an airline level;
- communications traffic requirements in terms of cumulative traffic volumes (bit rates) for the identified services;
- revenue estimations and their dependency on assumed pricing models and parameter values.

As a major outcome, both volume-based and flat pricing strategies can be applied such that significant revenue potential can be observed for satellite-based APC while the prices seem affordable for passengers. However, flat pricing tends to provide some inherent advantage over volume-based pricing,
since similar revenues can be achieved at reduced risk and with lower sensitivity to actual acceptance and service usage through passengers.

Section 5 provides an approach to a coherent capacity analysis for global ATM systems based on GEO satellite systems employing spot beams; the current Inmarsat I-4 constellation is used as example. This approach covers

- a simulation-based calculation of aircraft numbers over regions/location and time (i) to feed spot-beam satellite system capacity dimensioning, and (ii) to feed later revenue estimations;
- in particular the extraction of peak aircraft numbers in GEO spot beams (peak instantaneous aircraft count – PIAC);
- statistical evaluation of the dynamics of air traffic per given area, e.g., a spot beam;
- a tailored modeling of ATM services – here we focus on air traffic control (ATC) services (ATS) – for the global complementary satellite scenario;
- a priority queuing analysis to calculate aggregate spot-beam capacities (i.e., cumulative bit rates).