

Satellite-enabled Air-Traffic Management: How will performance be tested and validated?

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Gatehouse
Satcom

Agenda

- Welcome and introduction to Gatehouse Satcom
- Why do we need satellite-enhanced ATM?
- How do we achieve satellite-enhanced ATM?
- Use case 1: Terminal performance validation
- Use case 2: End-to-end testing

Presenters



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Gatehouse Satcom

We are on a mission to be the world's leading satcom software supplier, unlocking unlimited and seamless connectivity.



25 years of experience working with +15 satcom technologies



Deployed software for Swift-Broadband Safety terminals



Serving the aviation industry with specialized network and link emulators



Why do we need satellite-enhanced Air-Traffic Management?

Aircrafts are **not always connected** to the ground.

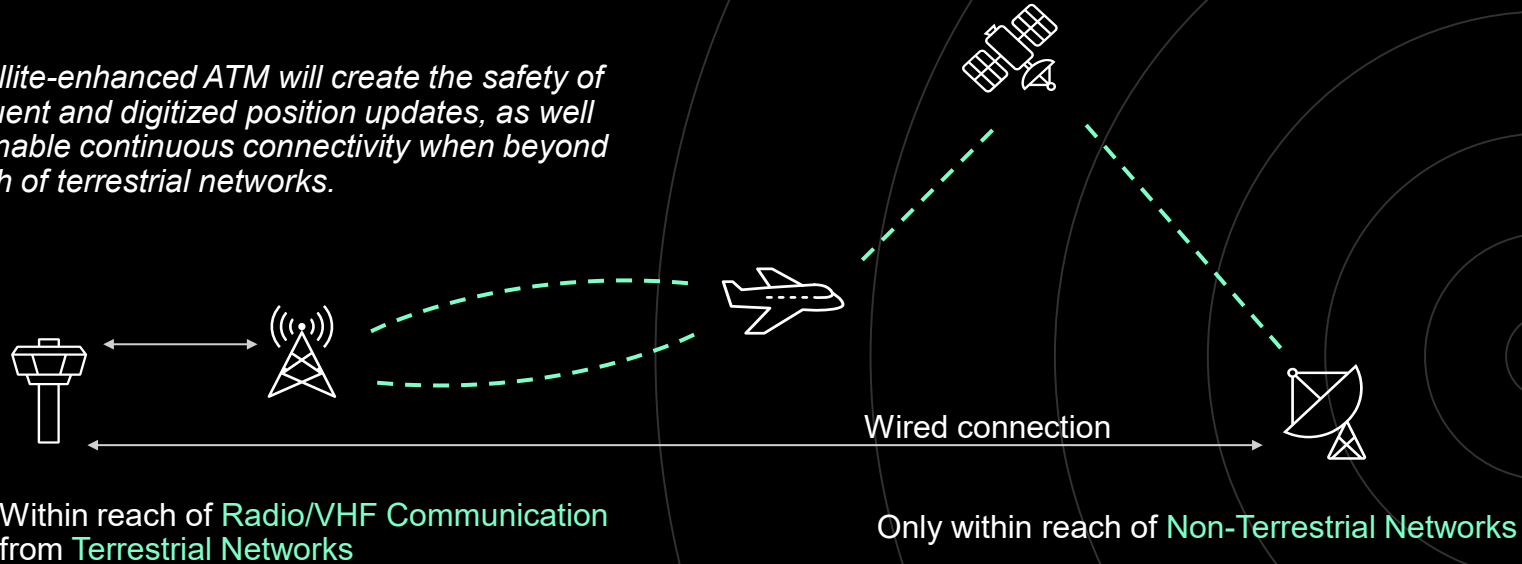
This leads to **inefficient** use of the skies due to wide safety margins in both time and space.

Enhancing ATM with a satellite-based datalink will lead to **safer** and more **sustainable** skies.



Aircraft connectivity **today** and **tomorrow**

Satellite-enhanced ATM will create the safety of frequent and digitized position updates, as well as enable continuous connectivity when beyond reach of terrestrial networks.



How do we achieve **always connected** skies?

To achieve safer and more sustainable aviation, we must integrate resilient and reliable satcom connectivity into the cockpit and incorporate the use into global regulations and standards.

To introduce satellite-based datalink to ATM we must:

- Develop, test and validate **individual elements**
- Perform full **end-to-end** integration and tests
- Incorporate satcom into the **ATM Standards**



What is the current **progress** of integrating satcom into ATM?

- SESAR
 - European initiative aimed at modernizing and improving the efficiency of air traffic management (ATM) in Europe.
- IRIS Programme (A key project under SESAR)
 - Purpose of IRIS is to provide satellite-based datalink service to support future ATM.
- Regulatory and Standardization Progress (EASA and EUROCONTROL and others)
 - Introduction of satellite communication is an on-going process, that may take several years to fully mature.

In summary, satellite communications is being actively incorporated into the standards of ATM but is still **in the developmental, testing and integration phases.**

DELIVERING
THE DIGITAL
EUROPEAN SKY



In the lab testing with advanced **digital twin simulation**

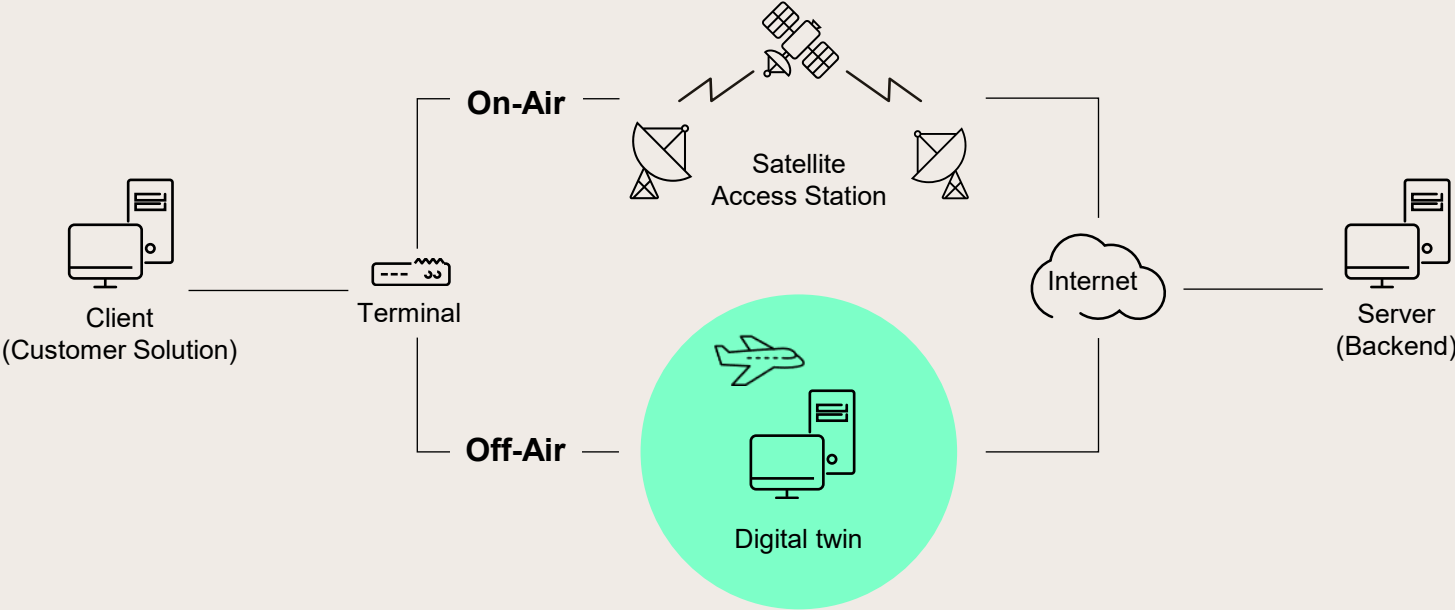
Performance of a satcom datalink depends on many components. Which of these can we simulate?

- A satellite network and datalink
- A flightpath
- Antenna characteristic/radiation patterns
- Aircraft model

Testing must be done in a **live** network environment as well as **in the lab** as both methods entail inherent possibilities and limitation.



ON-AIR VERSUS OFF-AIR VALIDATION OF SATELLITE CONNECTIVITY



How do we test and validate **individual components**?

Performance of a satcom datalink depends on many components.

Components like **user terminals, antennas and applications** must all be tested and validated individually.

This can and should be done both in a **live** network environment as well as **in the lab**, to ensure corner case verification and validation.



Use Case 1: **Terminal performance** validation

→ *As a system integrator I want to test my terminal using different aircraft antenna configurations so that I can validate its operation and performance. A 4D trajectory input shall emulate aircraft banking and tail blocking and thus result in realistic satellite data link impairments.*



Flight path emulation

Introducing the flightpath enables you to verify and validate your terminal's performance during:

- Handovers,
- channel impairments,
- aircraft banking and tail blocking,
- connection recovery, interference, and more.

Input:

- Antenna type
- Airplane model
- Flight route

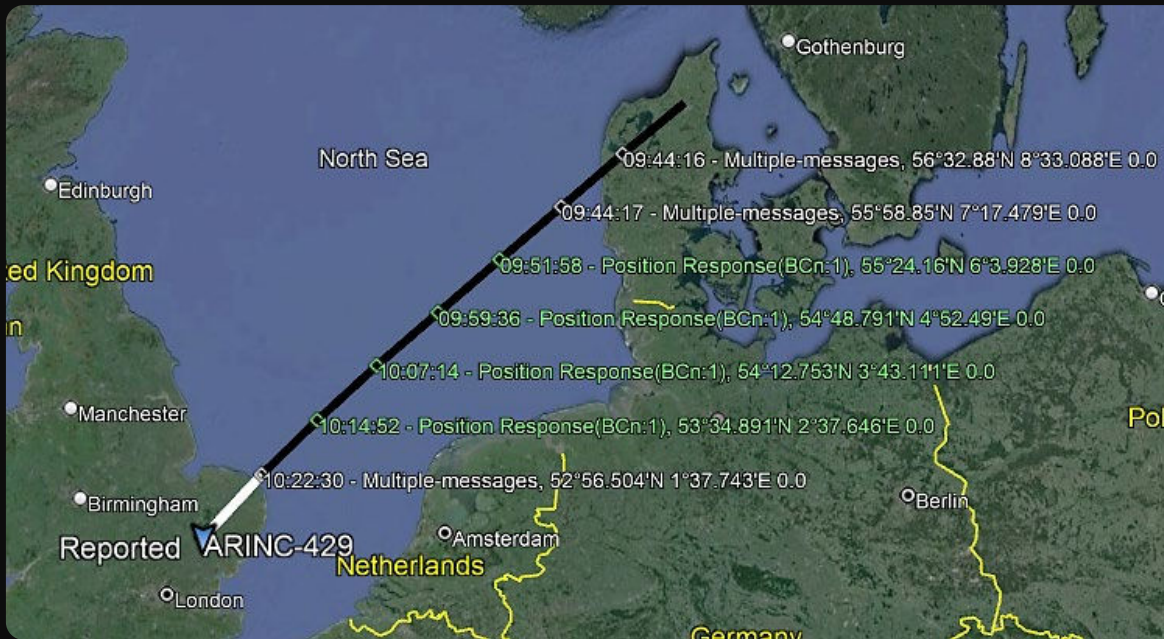


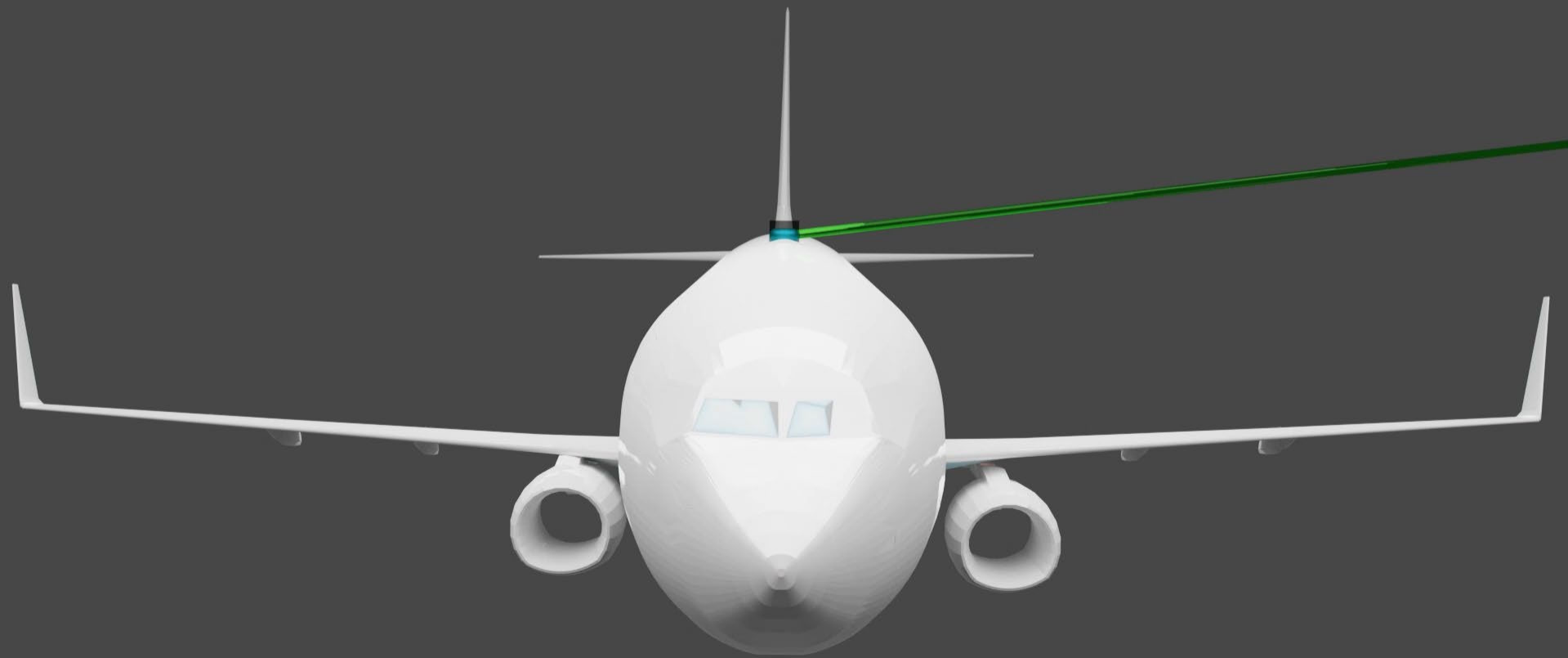
Flight route

The flight route tells the digital twin solution where the aircraft is at a certain point in time, and how the aircraft is turned.

The route is aligned with ARINC429.

You can take actual flight logs and convert them into route files.





How do we test and validate **end-to-end**?

When individual components are validated to individually be able to achieve a reliable datalink performance, we must perform end-to-end verification and validation testing.

This can and should also be done both in a **live** network environment as well as **in the lab**, to cover corner cases.

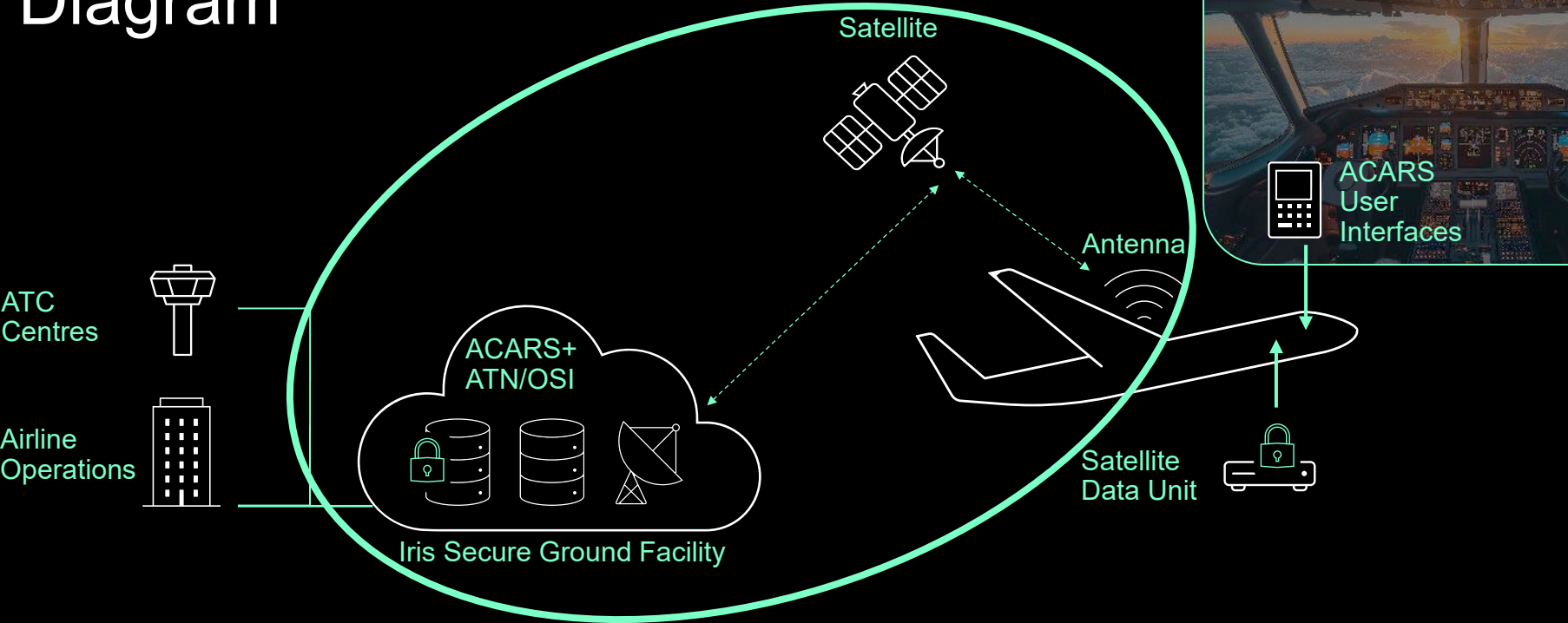


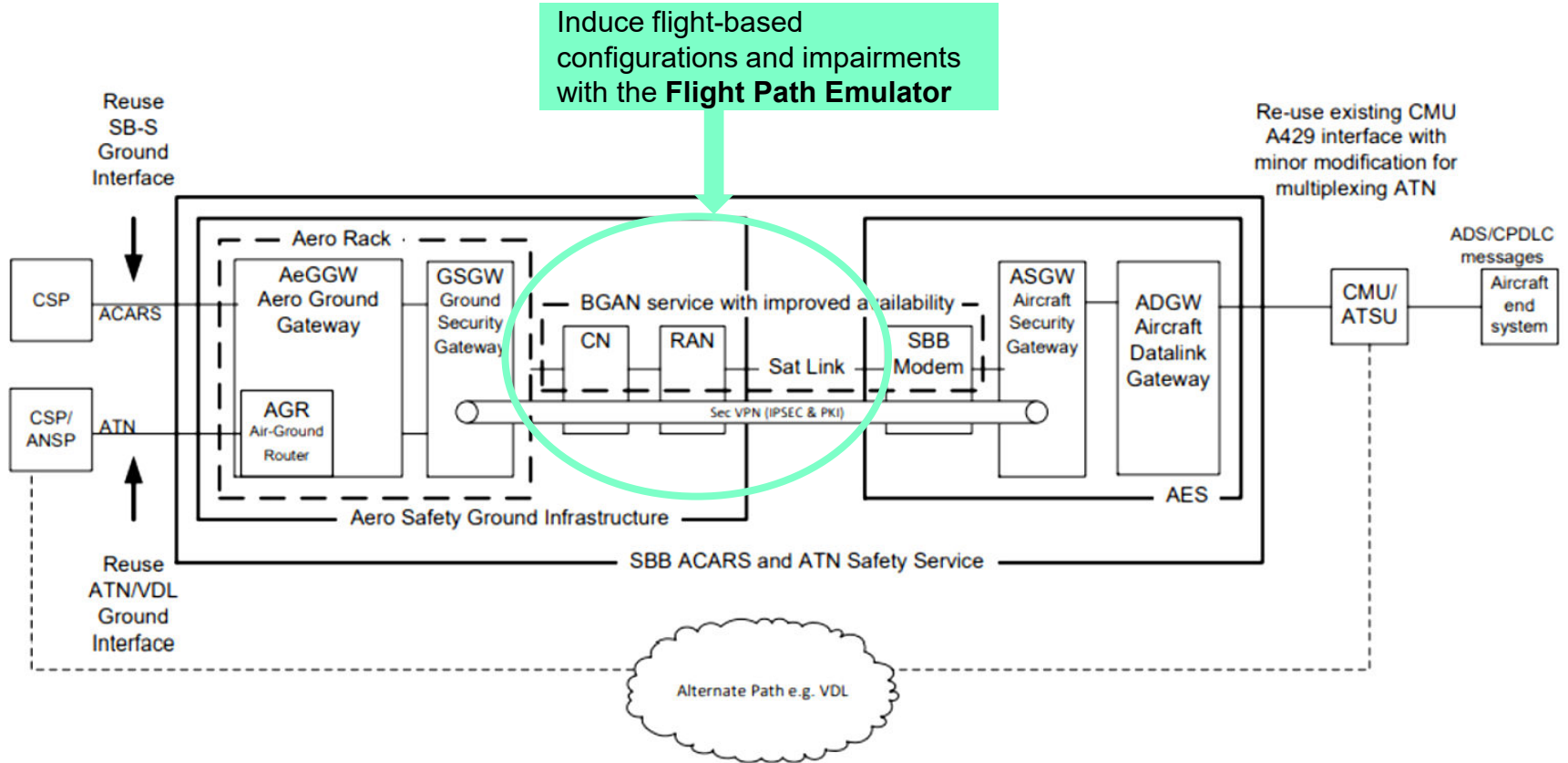
Use Case 2: **End-to-end** testing



→ *As a system owner, my top priority is to deliver the best possible datalink, no matter the circumstances. There is a myriad of ways a datalink can degrade during flight, so I need to test the system end-to-end and actively impair the connection while testing. The Flight Path Emulator shall implement impairments and disturbances based on a simulated flight quick and easy, helping me harden my system further.*

High Level **End-to-end** Diagram





Satcom specific **conditions** and **impairments**

Satellite communication links face certain impairments and physical conditions, which we simulate to ensure robust and resilient data connections.

- Signal degradation
- Latency
- Doppler effect
- Jitter
- Handover



Why do we **verify** and **validate** datalink performance?

Using a Digital Twin setup to verify and validate a satcom datalink's performance is essential to attain sufficient test depth and width that is required for any component intended for aviation purposes.

Proving a system works is not enough, we need to test tirelessly to ensure that it **always** works.

Did you know?

The cost of a digital twin setup equates the price of 1-2 days of on-air testing in an airport.



A statement from Viasat™

“ With the number of aircrafts in operation expected to double between 2022 and 2042, the industry must act to ensure the already crowded airspace can handle this growth. Off-air testing using digital twin technology, such as the Flight Path Emulator, plays a vital role in achieving safely connected skies.

Viasat has enjoyed a long-standing partnership with Gatehouse Satcom, whose expertise in satellite communications off-air testing has been invaluable. Their support of terminal and application developers across our community has been instrumental in advancing reliable, cutting-edge satellite communication solutions.

We greatly value their contribution to our shared mission of driving innovation in the satcom industry.”

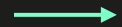


Joel Klooster, Senior Vice President, Aircraft Operations & Safety, Viasat

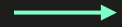
Summary

Digital twin solutions is a key element to speed up **development** and proving the **performance** and **resilience** of satellite-enhanced datalinks for Air-Traffic Management.

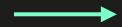
Want more insight into **satellite network** and **link emulation**?



With over two decades of experience in the satcom industry, we are deeply embedded in the community. We are always eager to partner with other visionary companies to create a more connected world for tomorrow.



Follow [Gatehouse Satcom on LinkedIn](#) for new discoveries and developments.



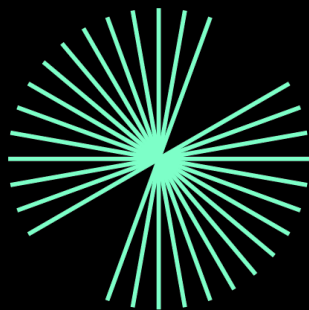
Do you have any question relating to test efforts for satellite-enhanced datalinks for Air-Traffic Management? Please send us your questions and we will get back to you directly.



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