4th Integrated CNS Technologies Conference & Workshop

A Data Communications Concept for a SATS Scenario

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Outline

- **Background**
- **SATS operational concepts**
- **One data communications concept for SATS**
- **Nominal scenario for data communications in a SATS operating environment**
- **Summary**

Background

- **Commercial air transportation system near its limit**
  - **18,000 airports in US, but 96% of passengers go through 140 airports because of "hub and spoke" approach used by airlines**
  - **21st century transportation demand cannot be satisfied by continuing to funnel almost all passengers through 140 airports**

Type of Airport	Number of Airports	Definition of Airport Type	Percentage of Enplanements
Large Hub	31	At least 1% of passengers	69.6%
Medium Hub	37	0.25% to 1% of passengers	19.3%
Small Hub	72	0.05% to 0.25% of passengers	7.7%
All Hub Airports	140	More than 0.05% of passengers	96.6%

Background

- **Small Aircraft Transportation System (SATS) vision**
  - **Safe and timely travel "doorstep to destination" transportation**
  - **Air transportation services (including very small economical jets) between 5,400 public use landing facilities**
    - **Scheduled services**
    - **On-demand (charter) services**
  - **An affordable means to close the 21st century gap between transportation demand and supply**

Background

- **SATS is part of the solution to transporting people efficiently**
  - **Provides the means to more effectively use the nation's airport capacity**
  - **Enables fast, safe, efficient travel to underserved airports**
  - **Allows more passengers to use airports closer to**
    - **Home**
    - **Final destination**
  - **Develops technologies that will enable the growth of safe small aircraft air taxi services**

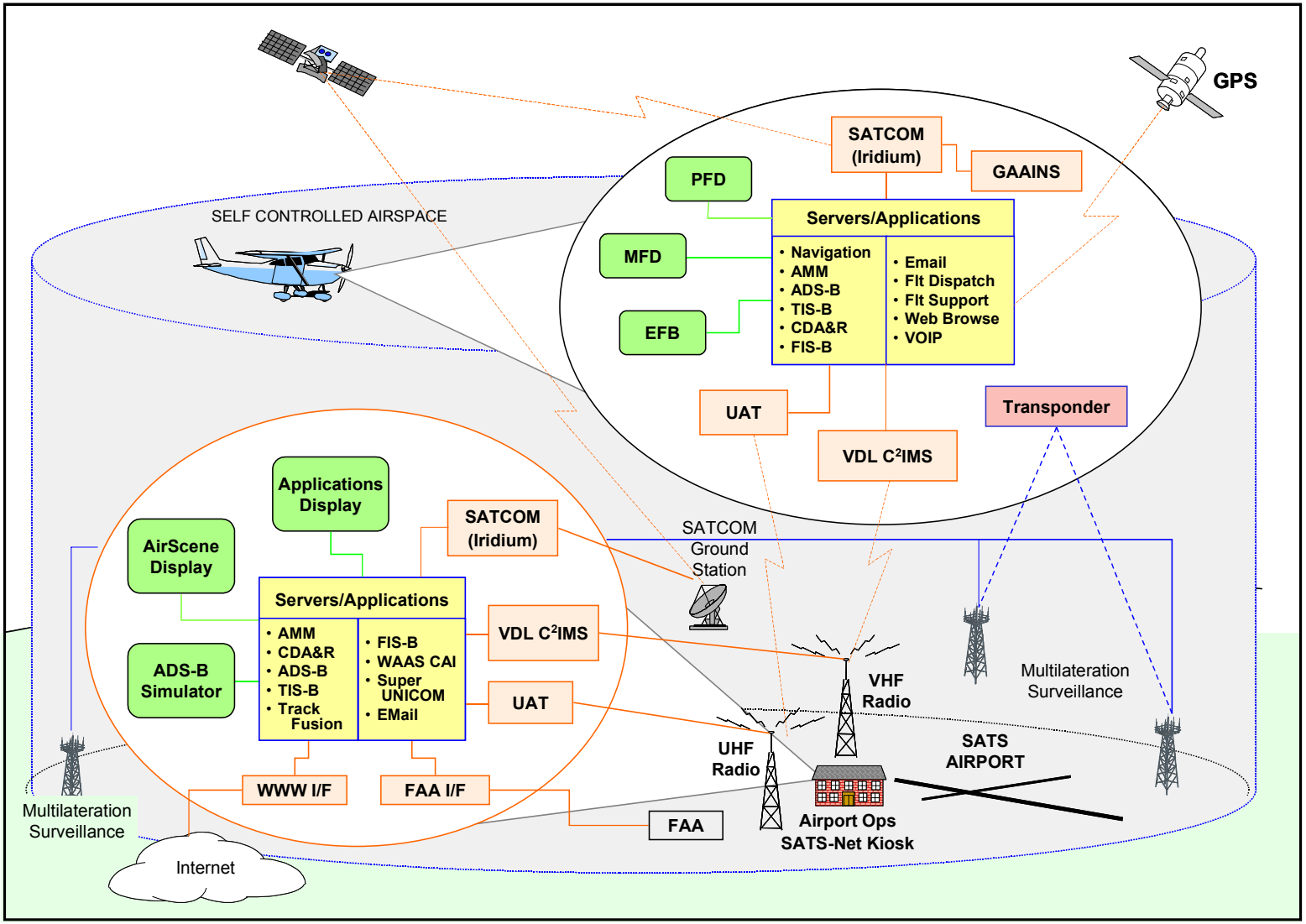
Background

- **Goals of the NASA's SATS Program**
  - **First steps towards long-term SATS vision**
  - **Develop key airborne technologies to provide integrated technology evaluation and validation**
- **NASA's program has four objectives centered on enabling operational capabilities**
  - **Higher Volume Operations (HVO) at non-towered/non-radar airports**
  - **Lower Landing Minima (LLM) at minimally equipped landing facilities**
  - **Increased single-pilot crew safety and mission reliability**
  - **En route procedures and systems for integrated fleet operations**

SATS Operational Concepts

- **Higher Volume Operations**
  - **Improve throughput at smaller, unattended airfields**
    - **Traditionally "one in, one out" during instrument conditions**
    - **On board avionics provide means for communications, navigation and surveillance**
  - **Self Controlled Area (SCA)**
    - **Nominally 10 nm radius around final approach fix**
    - **Surface to 3,000 feet AGL**
    - **Use of free flight and self separation to minimize delay**
    - **Minimum equipment set required to operate in SCA**
      - » **Automatic Dependent Surveillance - Broadcast (ADS-B)**
      - » **VHF Digital Link (VDL) radio**
      - » **GPS navigation system**

Notional SCA Architecture



Data Communications Concept for SATS

- **Data communications is a key component of SATS vision**
  - **Enhances operational performance**
  - **Increases throughput at SATS airfields**
  - **Improves situational awareness**
- **Air and ground data communications components**
  - **Support Communications, Navigation and Surveillance (CNS) applications**
  - **Support aircraft in all phases of flight**
    - **Departure**
    - **En route**
    - **Approach**
    - **Landing**

Data Communications Concept for SATS

- **Multiple communications links**
  - **Universal Access Transceiver (UAT)**
  - **VHF Digital Link (VDL)**
  - **Mode A, C and S transponders operating on 1030 and 1090 MHz**
  - **Satellite communications**

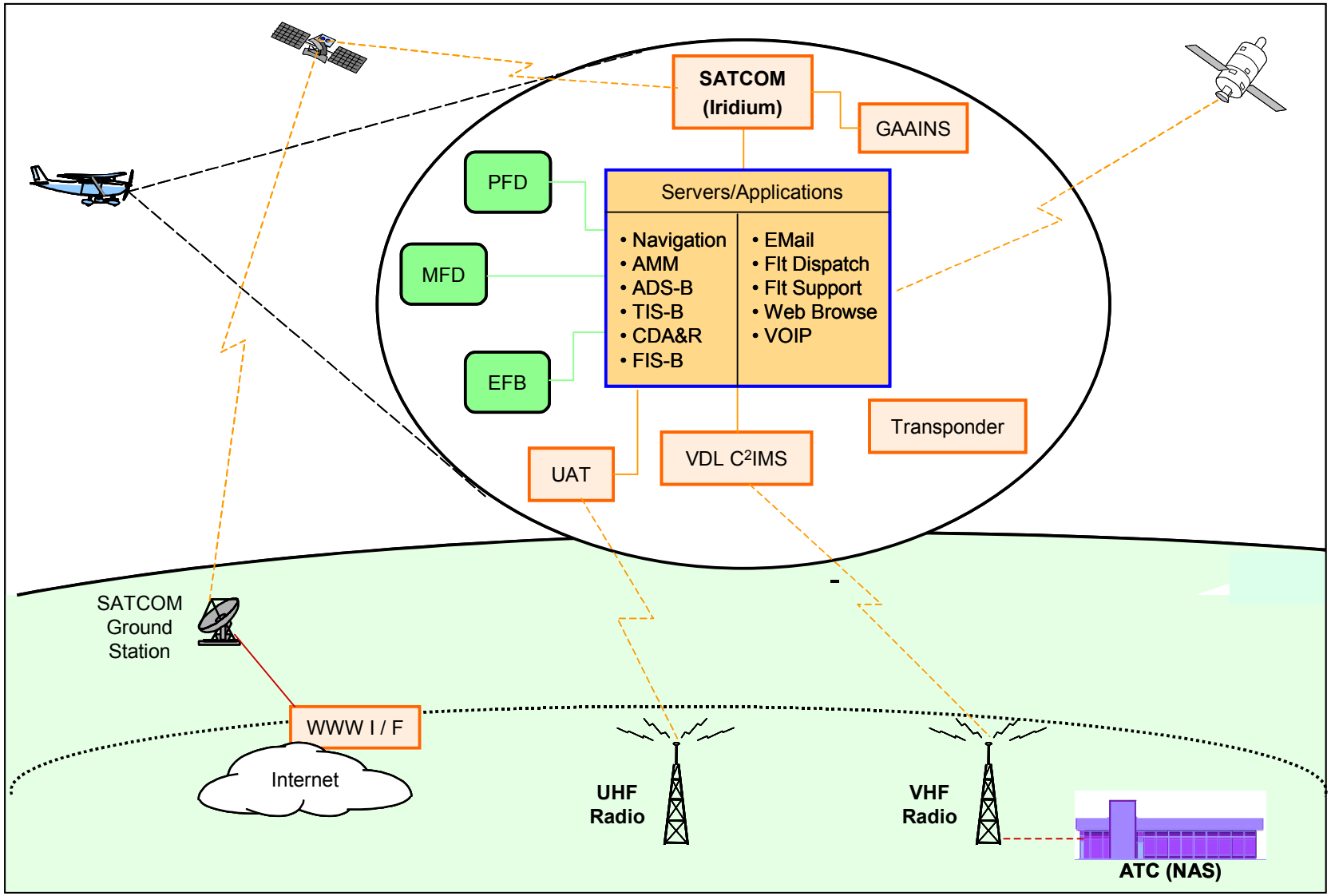
Data Communications Scenario

- **Pre-flight activities**
  - **From home or office, pilot can use Electronic Flight Bag (EFB) (i.e., PDA, tablet PC, etc.) to establish a wireless connection to the Internet**
    - **Check weather forecasts**
    - **Check departure readiness (aircraft, fuel, etc.)**
    - **Check destination services (fuel, maintenance, car rental, etc.)**
  - **File flight plan via FAA's Direct User Access Terminal Service (DUATS)**
- **Flight planning**
  - **No unique SATS requirements**
  - **Communicate using EFB or traditional voice**

Data Communications Scenario

- **Departure**
  - **Taxi**
    - **Aircraft position provided to others via ADS-B or ground-based multilateration system**
    - **Runway incursion system monitors potential runway incursions or collision hazards**
    - **If conflict occurs, system broadcasts an alert and resolution advisory**
  - **Takeoff**
    - **Pilot monitors onboard traffic display to identify a potential departure slot**
    - **Once departure slot is confirmed and a safe departure ensured, pilot taxis onto runway and takes off**
    - **While climbing out, pilot contacts ATC for further clearance via voice radio**

En Route Segment



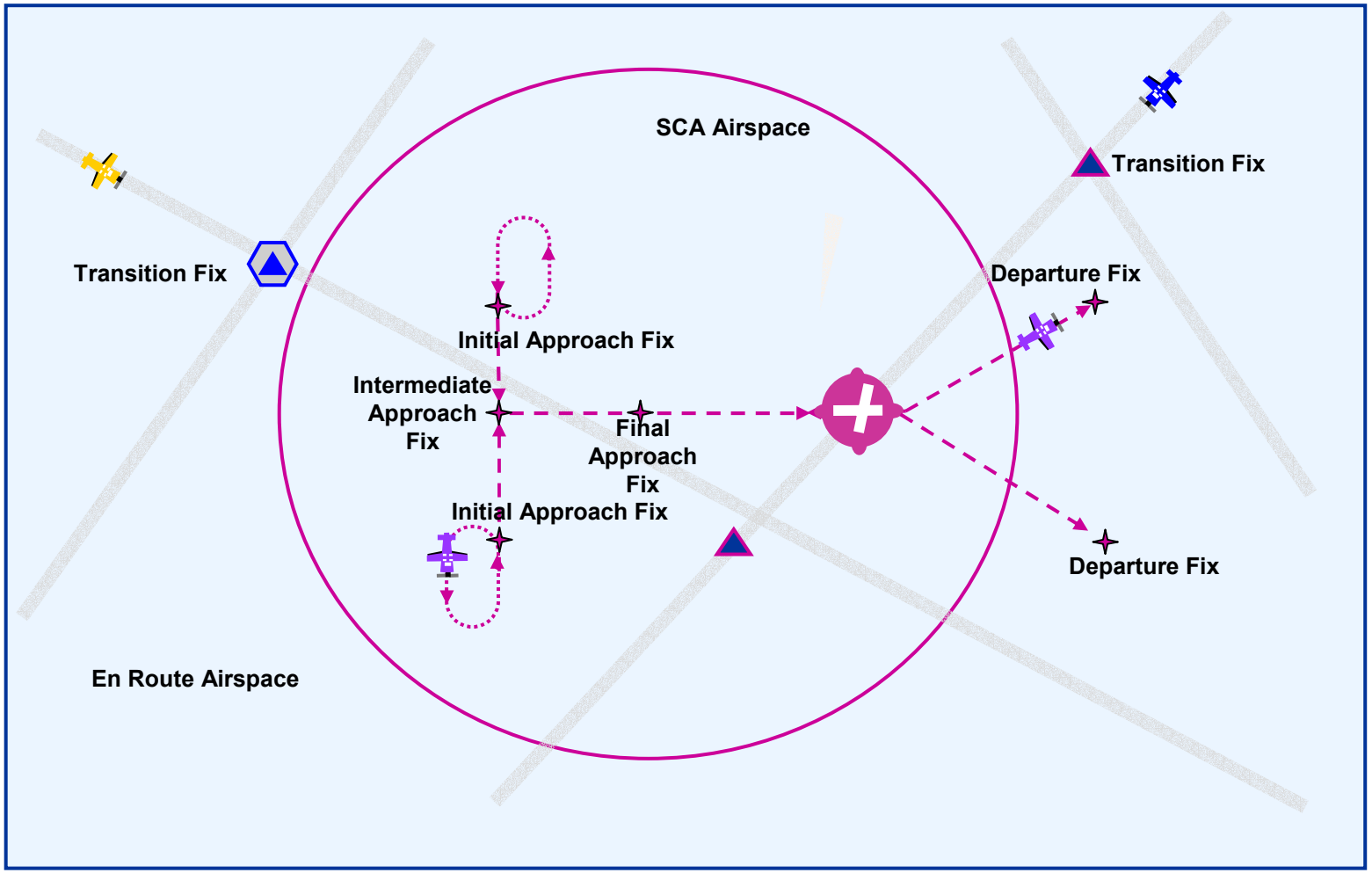
Data Communications Scenario

- **En Route**
  - **Pilot communicates with ATC via voice radio**
  - **Navigation performed using GPS and WAAS**
  - **Situational awareness is enhanced through use of ADS-B and TIS-B information displayed on CDTI**
  - **Aircraft is also equipped with conflict detection and alerting system**
  - **Aircraft receives flight information services via voice or datalink, including weather and airspace situation**
  - **Other wireless services, such as Internet access and email, may also be available to the pilot or passengers via satellite communications or VHF datalink**

Data Communications Scenario

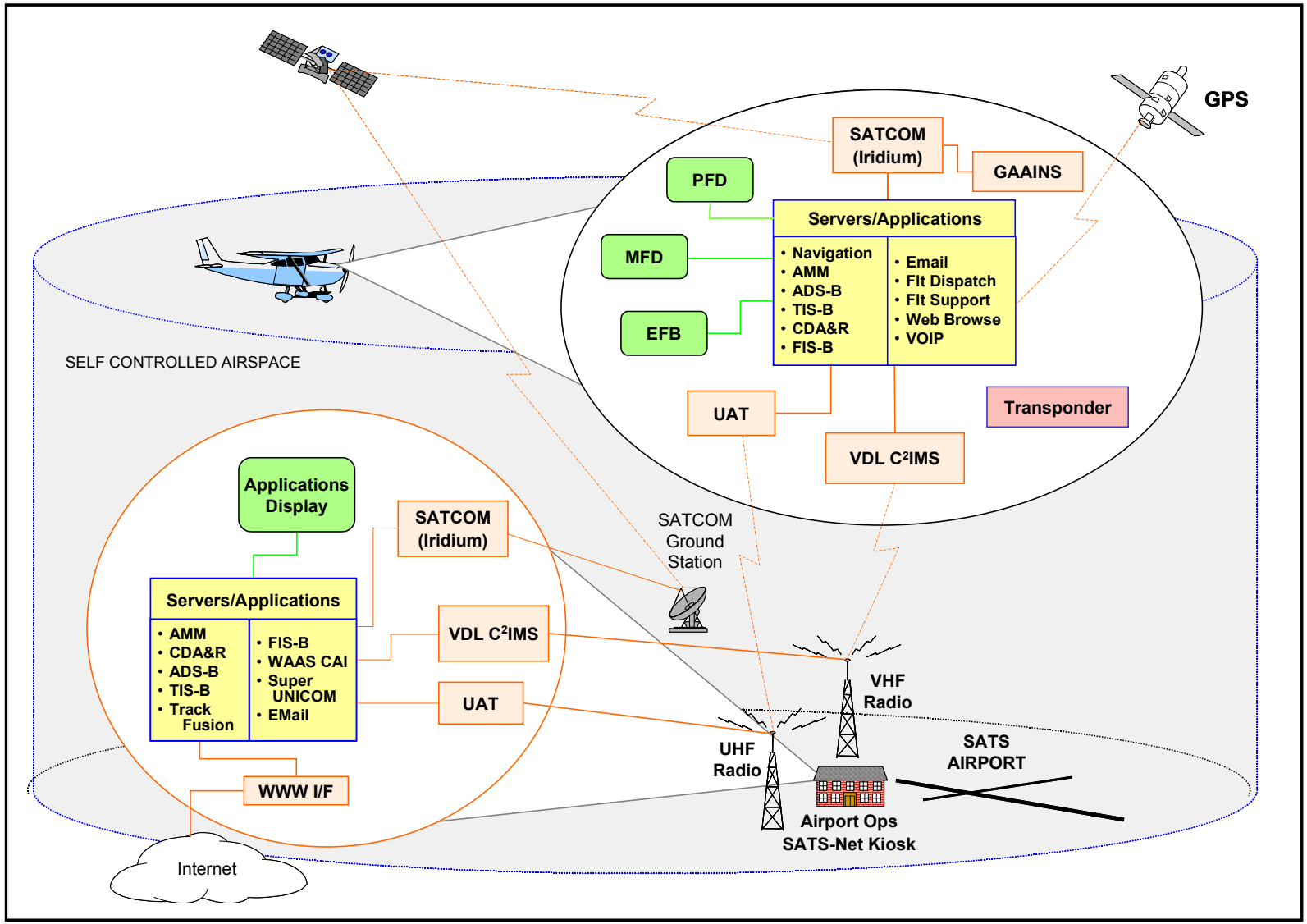
- **Transition from ATC airspace**
  - **Nearing transition fix, pilot tunes VDL radio to airport frequency to check status of Self-Controlled Area (SCA)**
  - **Ground-based Airport Management Module (AMM) monitors traffic situation using ADS-B data and broadcasts "state of the SCA"**
  - **Pilot requests approach sequence from AMM**
  - **AMM broadcasts sequence information and SCA status**
  - **Pilot requests clearance from ATC to depart transition fix and enter SCA**
  - **Pilot maintains situational awareness using ADS-B reports**
  - **Once cleared, the pilot descends to lowest available altitude at the initial approach fix (IAF) and holds**

Data Communications Scenario



Notional SCA Concept

Approach Segment



Data Communications Scenario

- Approach and landing
  - Pilot descends in holding over the IAF until he/she is next for approach
  - Maintains safe separation by monitoring aircraft on MFD
    - ADS-B and TIS-B provide aircraft locations
  - Conflict alert to pilot when a traffic conflict exists
  - Flies the approach as published to a landing
  - If unable to land safely, executes a missed approach
  - If a missed approach, AMM broadcasts a new sequence assignment when the aircraft nears the missed approach fix
  - After landing, pilot closes flight plan with flight service station using a cell phone or the Voice over Internet Protocol (VoIP) capability of aircraft avionics

Summary

- **Data communications are a key component of the SATS vision**
  - **Improved performance**
  - **Enhanced situational awareness**
  - **Increased throughput at SATS airfields**
- **Data communications support all phases of flight**
  - **Preflight activities**
  - **Flight planning**
  - **Departure**
  - **En route**
  - **Approach and landing**

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