

# **Aeronautical Communications – An Important Enabler for Risk Mitigation**

**International Air Safety & Climate Change Conference (IASCC) 2010**

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# Overview

- **Developments in Air-Traffic Management (ATM)**
  - European air-traffic is expected to double by 2025/2030
  - New ATM concepts for more efficiency, greenness, and safety are developed (SESAR, NextGen)
- **Consequences for aeronautical communications**
  - Increased capacity for communications required
  - Paradigm shift from voice to data link communications, e.g. 4D trajectories cannot be handled by voice
  - **State-of-the-art communications** have to be supplemented by **future communications concepts**
  - Aeronautical communications has the **potential to enable risk mitigation** in the near future



# State-of-the-Art Communications

- Main pillar in communication between pilot and controller is still **analog voice**
- Recently first **digital data links** introduced
- Analog voice communications
  - Voice communication in **VHF-band** (118-137 MHz)
    - ◆ “Double Sideband Amplitude Modulation” (DSB-AM) technology introduced more than 50 years ago
    - ◆ Channel bandwidth 25 kHz (8,33 kHz introduced since 1999 for FL 245+ and since 2007 for FL 195+)
  - Voice communication in **HF-band** (2,8-22,0 MHz)
    - ◆ “Single Sideband (SSB) Modulation”
    - ◆ Channel bandwidth 4 kHz, bad voice quality
    - ◆ Used for remote areas without VHF voice coverage



# State-of-the-Art Communications

**ACARS:** Aircraft Communications Addressing and Reporting System

**VDL:** VHF (Very High Frequency) Digital Link

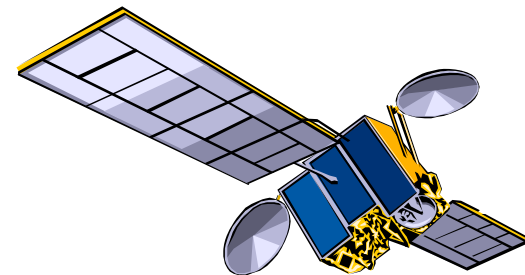
**HFDL:** High Frequency (HF) Data Link

## ■ Digital (data link) communications

- **ACARS:** VHF, MSK with 2,4 kbit/s, for AOC only
- **VDL Mode 2:** VHF, D8PSK with 31,5 kbit/s, CSMA, currently introduced in Europe
- **VDL Mode 3:** Standardized but not introduced
- **VDL Mode 4:** Standardized but not introduced
- **HFDL:** HF, M-PSK with up to 1,8 kbit/s

## ■ Satellite communications

- **Inmarsat:** GEO (4), up to 432 kbit/s for SwiftBroadband, less for Swift 64 and classic services
- **Iridium:** LEO (66), up to 9,6 kbit/s
- **Globalstar:** LEO (48), up to 9,6 kbit/s





## State-of-the-Art Communications

**State-of-the-art communications  
might not be sufficient  
for enabling efficient risk mitigation**

- Available data link capacity and data rates
- Missing connectivity between data links

# Future Communication Concepts

## ■ Current data link developments

- Aeronautical Mobile Airport Commun. System – [AeroMACS](#)
  - ◆ Airport data link based on WiMAX (IEEE 802.16e)
  - ◆ Very high data-rate, broadband data link (5/10 MHz)
  - ◆ Mobile (aircraft) and portable (sensors) applications
- L-Band Digital Aeronautical Commun. System – [L-DACS](#)
  - ◆ L-DACS1: Broadband FDD system based on OFDM multi-carrier technology like WiFi, WiMAX, and LTE
  - ◆ L-DACS2: Narrowband TDD single-carrier system
  - ◆ Decision after prototyping and compatibility measurements, both performed within SESAR Joint Undertaking



DLR L-DACS1  
Prototype

# Future Communication Concepts

## ■ Current data link developments

- Satellite-based ATM communications system – [ESA Iris Project](#)
  - ◆ Dedicated European satellite system for ATM for oceanic and remote areas and as supplement for continental airspace
  - ◆ Envisaged final deployment: around 2020
  - ◆ Phase 1 (finalized): System definition
  - ◆ Phase 2 (running): System development, including standardization and validation
  - ◆ Phase 3 (planned): In-orbit verification and certification of pre-operational system, technical support to full system deployment
- Direct [air-to-air](#) communications
  - ◆ Recently started research activity, e.g. by DLR
  - ◆ Goal: Air-to-air connectivity beyond ADS-B as provided by SSR Mode S or UAT



# Future Communication Concepts

**NEWSKY:** Networking the Sky  
**SANDRA:** Seamless Aeronautical Networking  
through int. of Data links, Radios, and Antennas

## ■ Aeronautical networking – “Networking the Sky”

- Several data links are available or in development:  
VDL Mode 2, HFDL, AeroMACS, L-DACS, SatCom
- Disparate communication systems are expensive and inefficient
- DLR vision “Networking the Sky”

Development of solutions for an aeronautical communication network based on IPv6 for the integration and interoperability of different services and different data links

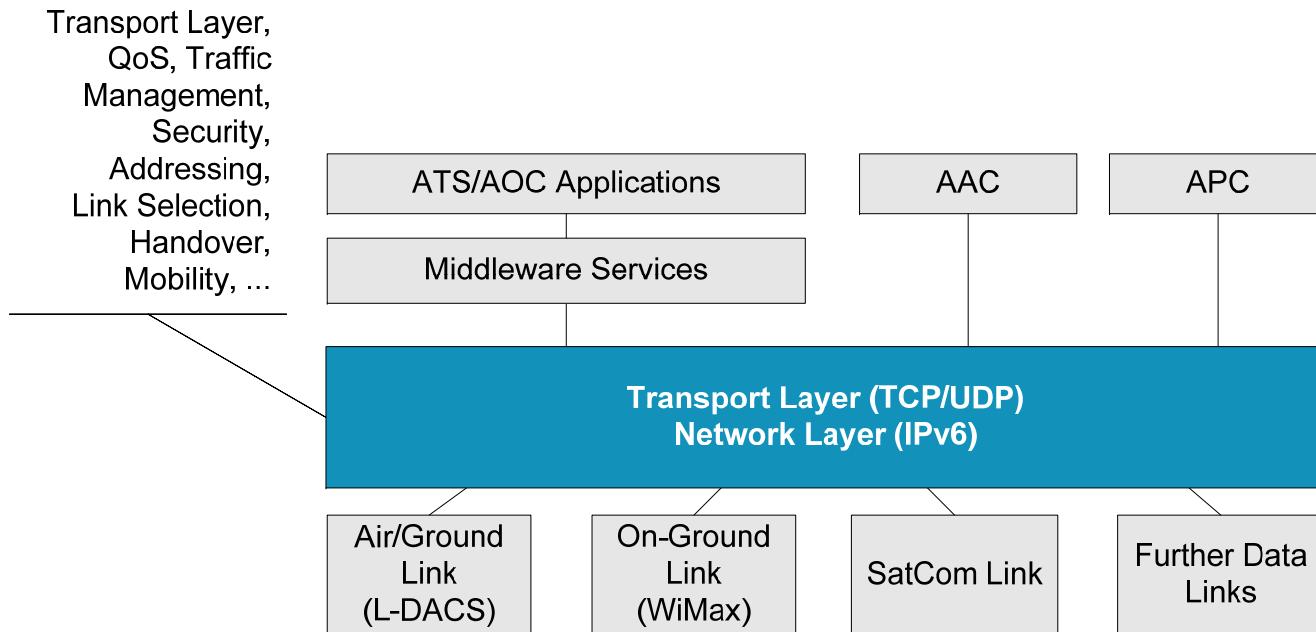
- ◆ EU project **NEWSKY**  
initiated and led by DLR proved feasibility  
and developed networking concept
- ◆ EU project **SANDRA**  
is aiming – as NEWSKY follow-up –  
at demonstrator implementation  
of networking concept



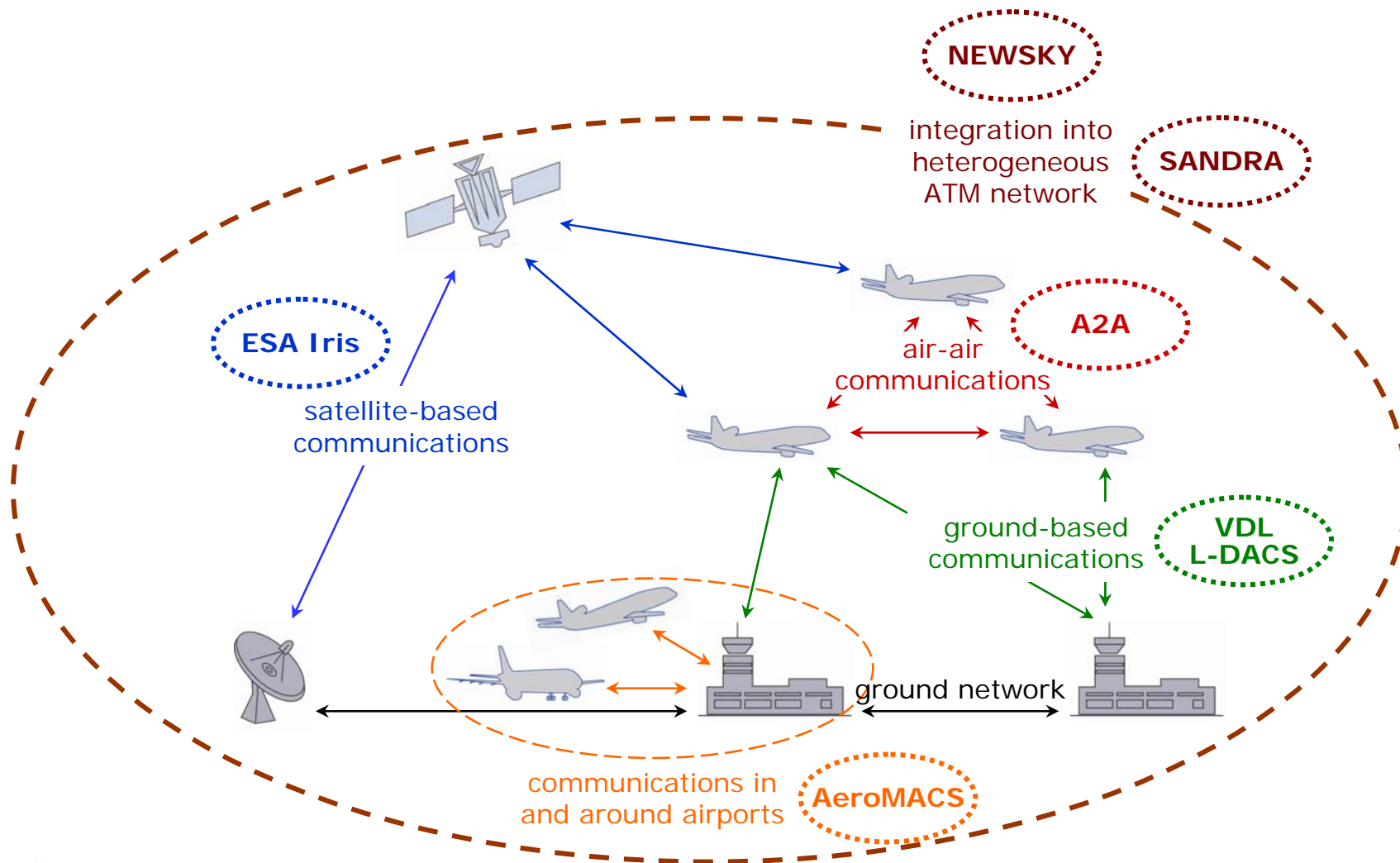


# Future Communication Concepts

- Aeronautical networking – “Networking the Sky”
  - The IPv6 based networking solutions aim at cost savings, high reliability and an optimal alignment with the evolution of communication and security technologies



# Future Communication Concepts – Summary





## Potential for Risk Mitigation

- Information of aircraft crews about weather effects
  - Using **dedicated links** – ground-based data links (VDL, L-DACS) or satellite links in remote areas
  - Using aeronautical **communications network**
  - Countermeasures are taken, e.g. re-routing of flight route
- Airborne sensor network
  - Each aircraft acts as a **sensor for meteorological data**
  - Sensor data is centrally collected on ground and processed
  - Global weather map is produced on ground
  - Aircraft in areas with (severe) weather effects are informed
  - **Prerequisite:** Broadband aeronautical communications network



## Potential for Risk Mitigation

- “Online” black-box
  - Black-box essential for avoiding future accidents
  - Sometimes data or black-box itself gets lost during accidents
  - Countermeasure:
    - ◆ Continuously **transmit black-box data to ground**
    - ◆ In case of accident, data is immediately available for inspection
  - **Prerequisite:** Broadband data link connection
    - ◆ Dedicated broadband satellite link
    - ◆ Broadband aeronautical communications network

## Conclusions

- In the medium-term, an aeronautical communications network is envisaged with potential for risk mitigation
- In the short-term, dedicated satellite links may be used
- **Applications for risk mitigation** should be defined (**asap!**)
  - Including requirements on data rate, latency, etc.
  - Important for consideration within future link development
- **Technology** for broadband communication is available
  - Problem is spectrum resource
  - Aeronautical spectrum is quite large, but inefficiently used
    - ◆ Modernization of SURV and NAV systems required
    - ◆ Rearrangement between SURV, NAV and COM required



## Conclusions

**Future communication concepts have the potential for risk mitigation**

- Demand and requirements must be clearly stated
- Resources (spectrum) must be made available

Questions?