



Integrated IP Networking for Air-Ground Communications – The NEWSKY Project

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Outline

- NEWSKY facts, addressed challenges, objectives, overall approach, benefits
- Selected results:
 - Mobility architecture
 - Data link management and handover framework
 - End-to-end data transport
- Standardisation
- Conclusion

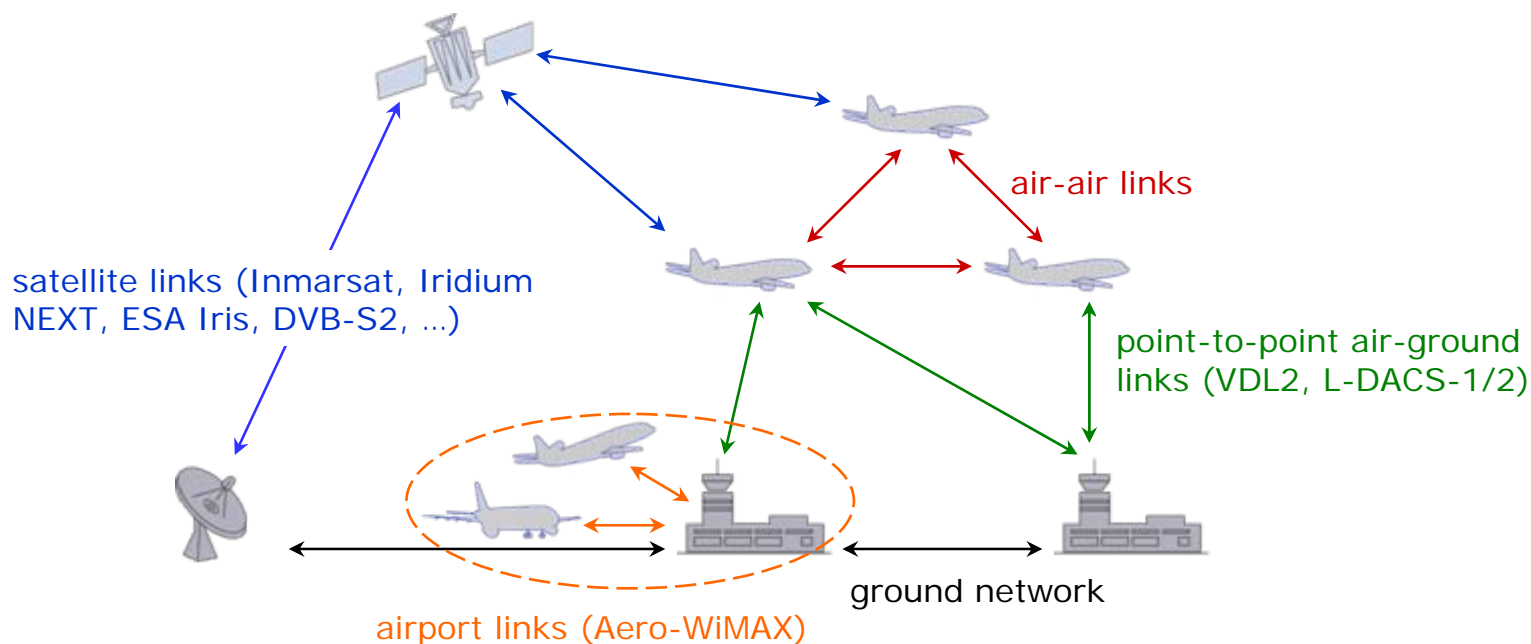
NEWSKY Fact Sheet

- European Commission FP6 STREP Project
- Time-Frame: February 2007 - August 2009
- Man-power effort: 250 PM
- Total financial volume: 3.6 M€
- Partners:
 - German Aerospace Center (DLR) (prime)
 - Thales Alenia Space
 - QinetiQ
 - Deutsche Flugsicherung (DFS)
 - TriaGnoSys
 - University of Salzburg
 - Frequentis
- Coordination with Eurocontrol and SESAR JU



Major Challenges Addressed: Different Data Links

- **Several current and future data links** are foreseen to be in operation to prevent the expected saturation of Air Traffic Management (ATM) communications and to fulfil the ATM communication requirements
- **Interoperability, modularity** and **efficient utilisation** of the overall communication system are of major importance



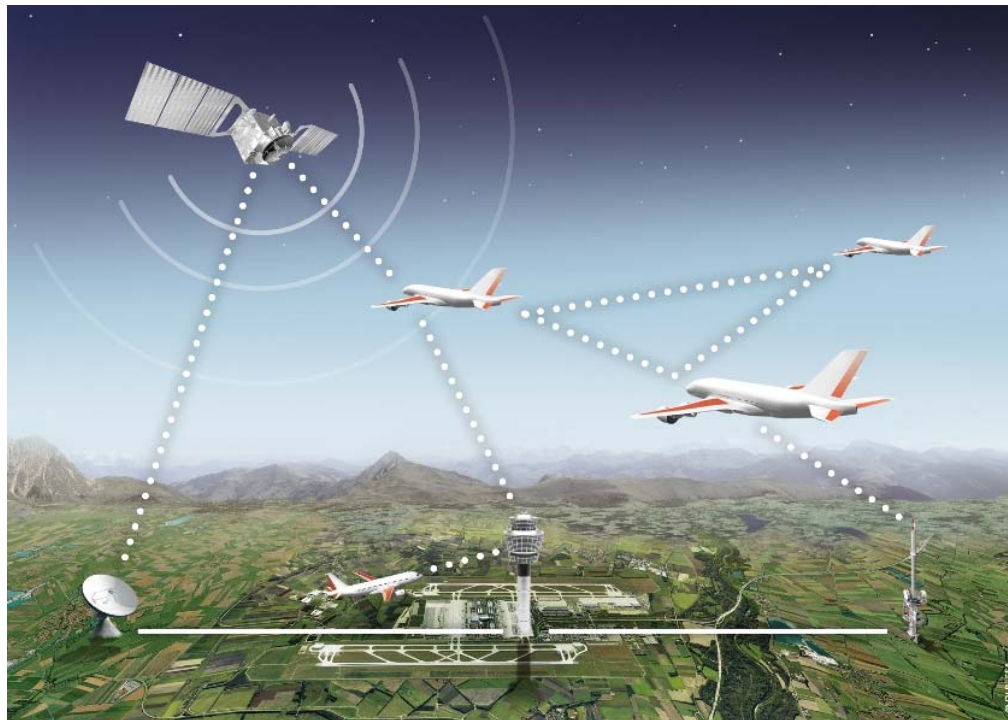
Major Challenges Addressed: Different Services

- **Several services** with highly diverse requirements shall coexist:
 - **ATS** (Air Traffic Services) will be primarily based on highly safety-related data communication and voice communication will be mostly used as fallback solution
 - **AOC** (Airline Operational Communications) data traffic will strongly increase for efficient airline operations
 - **APC** (Air Passenger Communications) is foreseen to be further developed to meet passengers' expectations of on-board communication services

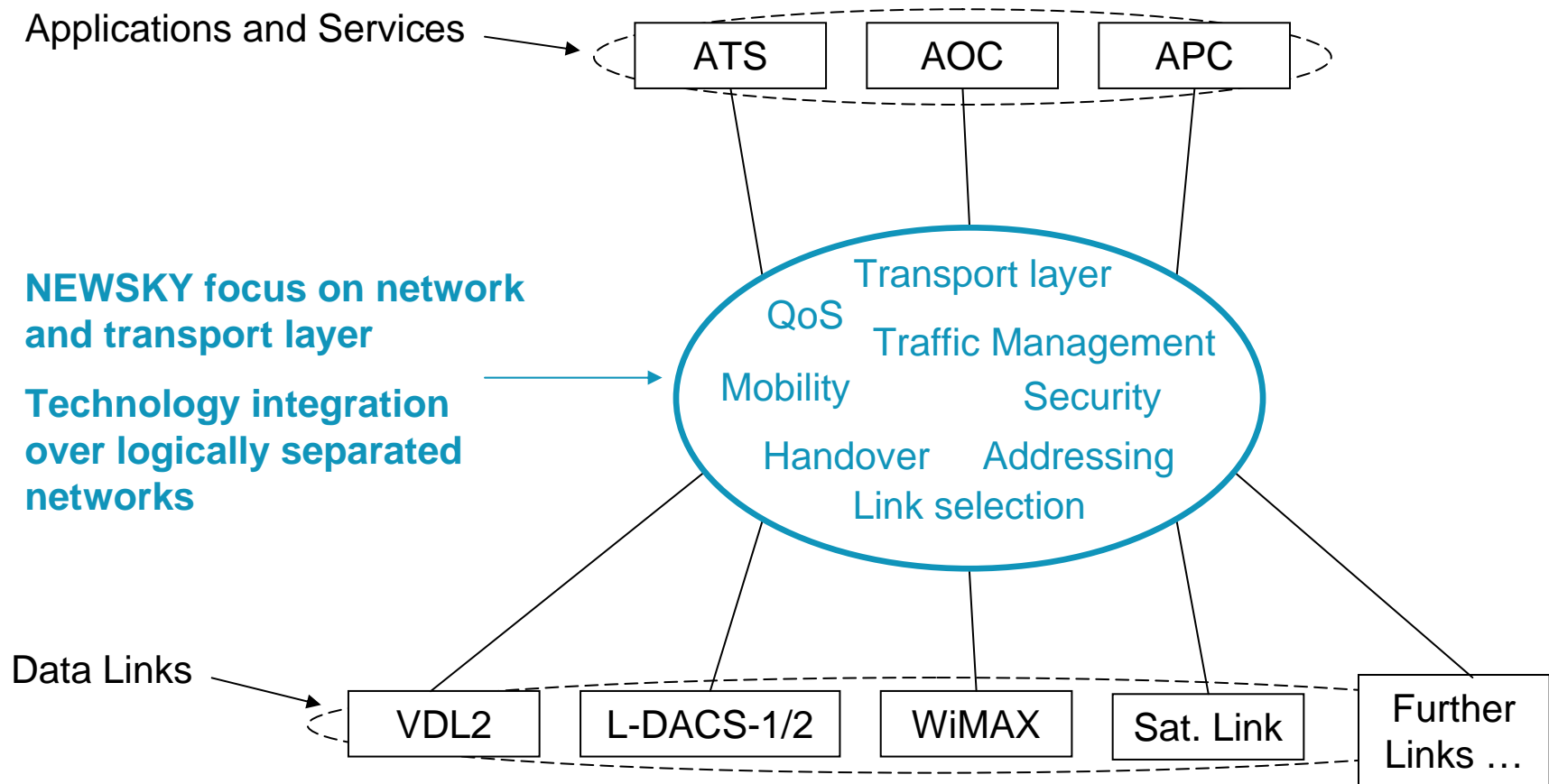
- Use of **synergies** is highly rewarding

Vision of “Networking the Sky”

- NEWSKY development of a concept and preliminary design of an **integrated aeronautical communication network** with focus on air-ground communications and the **integration of data links and services**

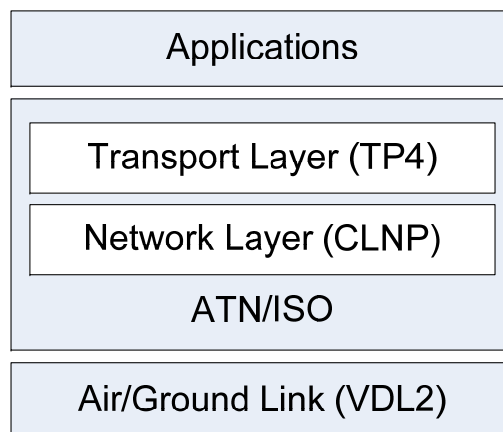


Integrated Approach



Networking Solutions: State-of-the-Art for ATM

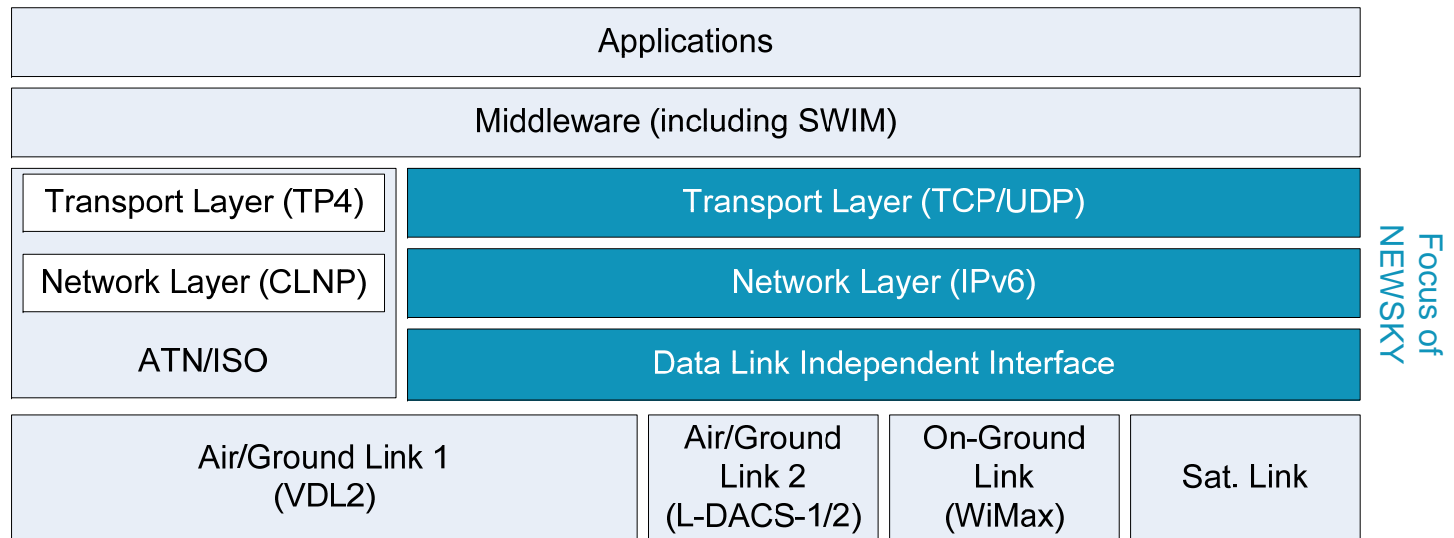
- ATN/ISO is being deployed in combination with VDL2 through e.g. the Link2000+ programme (VDL2/ATN):



- Commercial networking solutions based on the widely deployed IETF Internet Protocol Suite (IPS) have diverged significantly from the aeronautical networking solutions based on ISO protocols.

Networking Solutions: Trend Towards IPv6

- Trend towards **IP-based networking solutions** for A/G communication for **cost savings, high reliability** and an **optimal alignment** with the evolution of communication and security technologies
 - ICAO WG-I specification of ATN/IPS
- NEWSKY **focus is on IPv6**, considering **interoperability** and the **transition** from ATN/ISO



NEWSKY Objectives

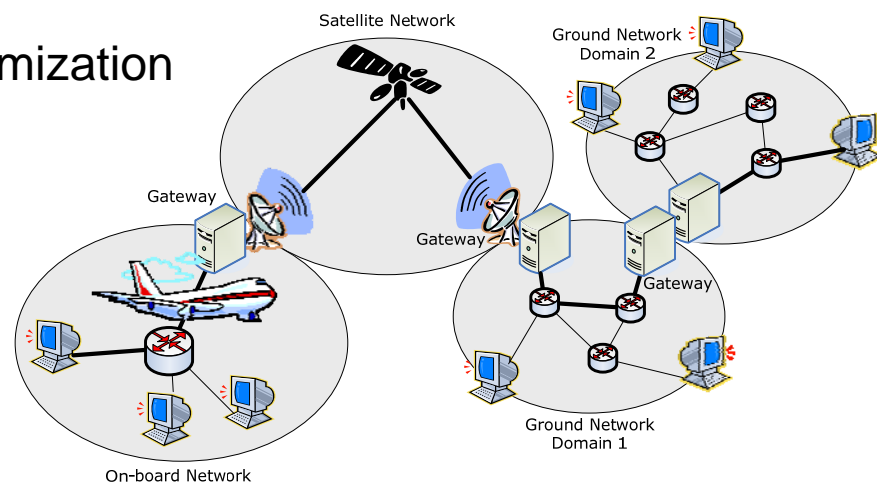
- Specification of **network and transport layer** solutions of a future integrated aeronautical communication network with focus on air-ground communications
- Focus on **IPv6** considering interoperability and the transition from IPv4, ATN/OSI, ACARS etc.
- Specification of networking solutions for the integration and interoperability of different **different services** (ATS/AOC/APC) and **different data links**
- Use of **well-proven industry standards** for cost-efficiency

NEWSKY Benefits

- **Interoperability** between different communication systems
- **Modular system concept** which enables simple introduction of new data link technologies
- **Optimised communications performance** for each type of application by using the right communication link technology at the right place and time
- **Efficient and flexible** utilization of the overall aeronautical frequency spectrum
- Increased **availability and reliability** through efficient use of different communication links
- **Cost savings**, high reliability and an optimal alignment with the evolution of communication and security technologies by using **well-proven industry standards** wherever possible.

Some Foreseen NEWSKY Results 1/2

- Investigations on Service Oriented Architectures (SOA)
- Characterisation of data link technologies
- Specification of functional and protocol architecture and of network topology
- **Resource Management**
 - QoS processing: QoS architecture, scheduling, queuing, congestion control
 - Link selection
 - Transport layer design and optimization



Some Foreseen NEWSKY Results 2/2

➤ **Mobility Management**

- Selection and optimization of MIPv6 extensions (NEMO, NETLMM, Multihoming)
- Specification of mobility architecture: Home Agent deployment ...
- Inter Satellite Routing, Mobile Ad-Hoc Network (MANET) routing

➤ **Handover framework**

- Adaptation of IEEE 802.21 for media independent handover signalling between data links and network entities

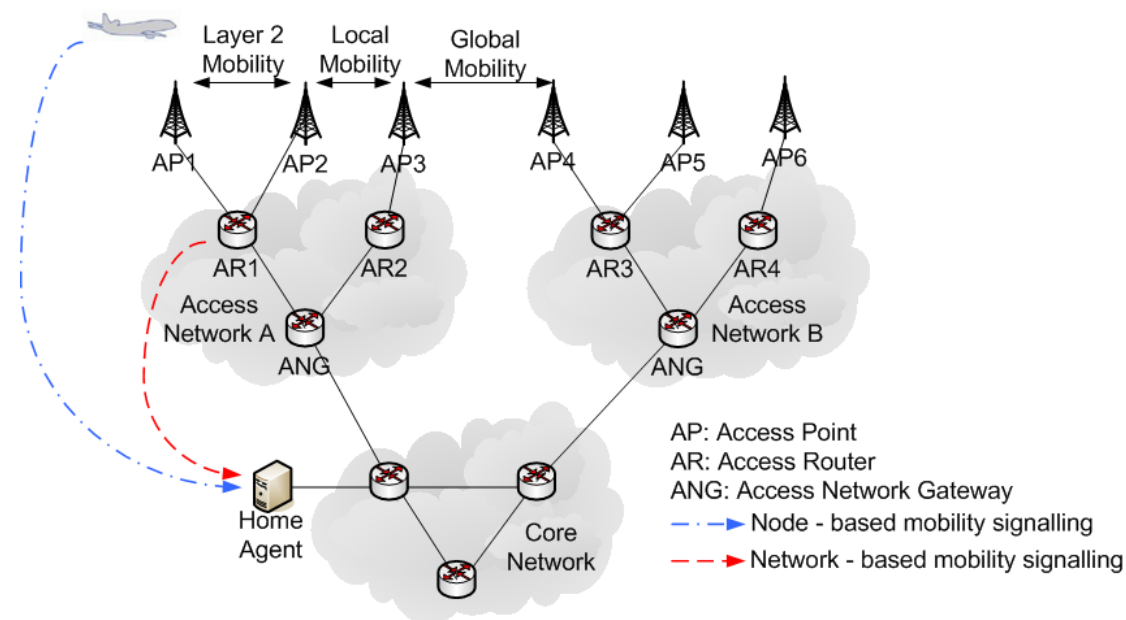
➤ **Security**

- Thread analysis, risk assessment, security architecture, service options & solutions

➤ **Validation** by computer simulations and laboratory test-bed trials

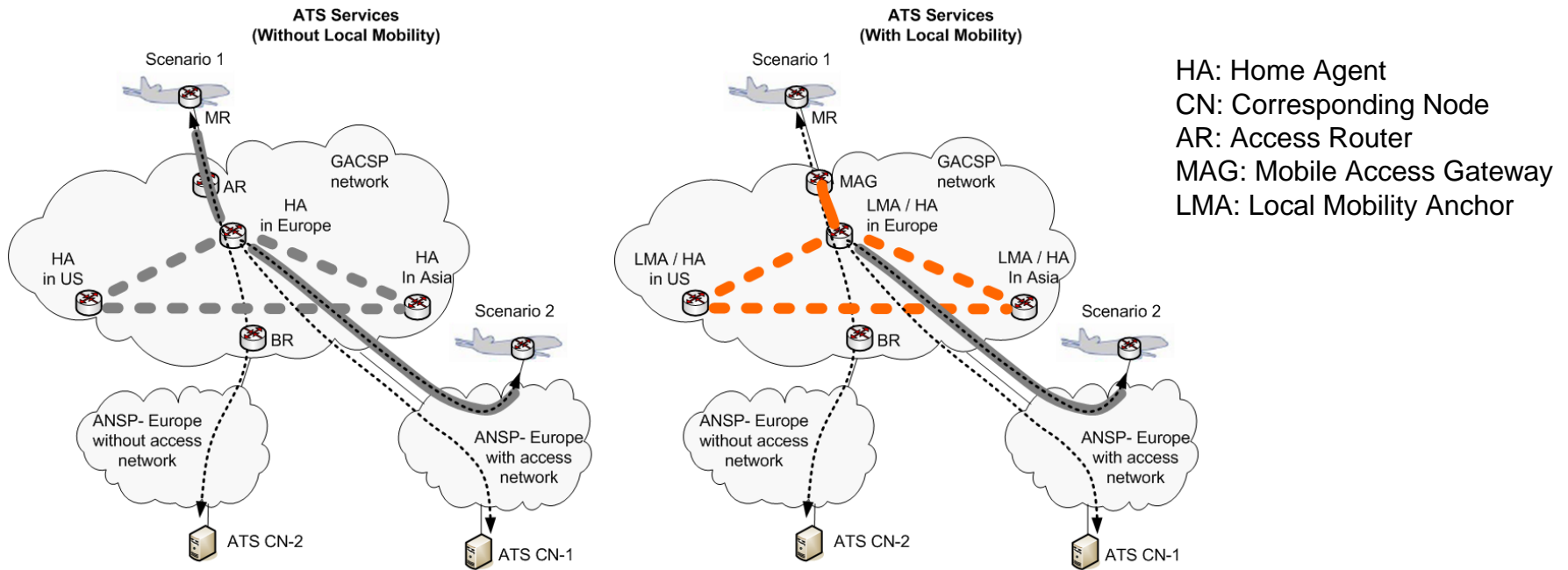
Mobility Framework

- Selection of Mobile IPv6 (MIPv6) and extensions:
 - host vs. network mobility
 - node-based vs. network-based mobility signalling
 - global vs. local mobility
 - route optimization
 - multihoming



Mobility Management: Proposed Solutions

- **NEMO** with adapted **Route Optimization** solutions for network mobility
- **PMIPv6** (Proxy MIPv6): network-based local mobility



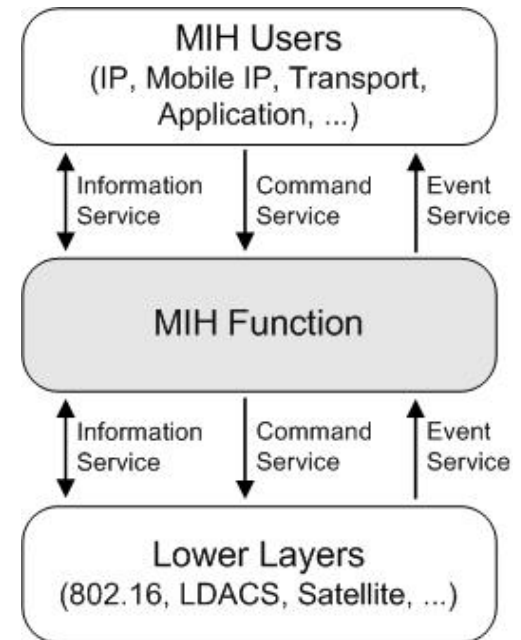
HA: Home Agent
 CN: Corresponding Node
 AR: Access Router
 MAG: Mobile Access Gateway
 LMA: Local Mobility Anchor

MR: Mobile Router
 HA: Home Agent
 MAG: Media Access Gateway
 AR: Access Router
 BR: Border Router
 CN: Correspondent Node

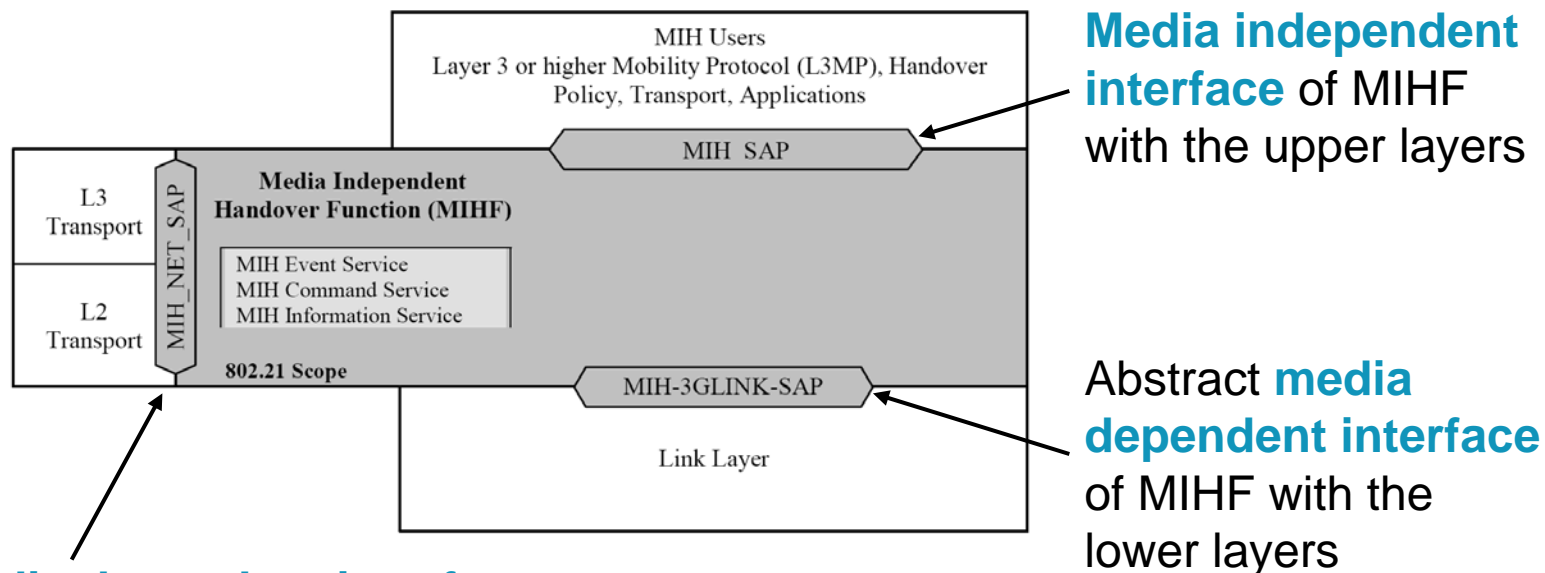
MR - HA Tunnel
 HA - HA Tunnel
 MAG - LMA Tunnel
 LMA / HA - LMA / HA Tunnel
 MR - CN Communication Path

Data Link Management and Handover Framework

- Solution based on **IEEE 802.21 Media Independent Handover Services**
- Logical entity between the link and the network layer:
 - ➔ **Media Independent Handover Function (MIHF)**
- Three service categories:
 - ➔ **Event Service**
Link layer trigger and information
 - ➔ **Command Service**
Link control commands: Request link information, trigger network-initiated and mobile-initiated handover
 - ➔ **Information Service**
Network information: List of available networks, location of base stations, service costs, ...



IEEE 802.21: Lower- & Upper-Layer Coupling



Abstract **media dependent interface** of MIHF which provides transport services over the data plane on the local node, supporting the exchange of MIH information and messages with the remote MIHF

End-to-End Data Transport

- Transport functionality to ensure end-to-end data delivery, with (e.g. TCP) or without (e.g. UDP) reliability.
- **Adaptations of TCP** are necessary depending on the technology used, as TCP performance is highly impacted by wireless technologies due to higher delays, error rates or profiles.
- Architectures investigated:
 - Performance Enhancement Proxies (PEP, TCP splitting and adaptation)
 - TCP selection in the end systems
 - Application Layer / Dialogue Service ACK

NEWSKY Contributions to Standardization

➤ ICAO WG-I

- Doc 9896 "Manual for the ATN using IPS Standards and Protocols"

➤ IETF MEXT (Mobility EXTensions for IPv6) WG

- Requirements, topology and solution space draft

➤ AEEC NIS (Network Infrastructure and Security)

- Project MAGIC – Manager of Air-Ground Interface Communications

Upcoming Activities

- FP7 SANDRA project: **S**eamless **A**eronautical **N**etworking through integration of **D**ata links, **R**adios, and **A**ntennas

- SANDRA pillars:
 - **S**eamless **N**etworking (NEWSKY direct follow-up activity towards integration with middleware services, full definition of interfaces with specific data link technologies, prototype implementation)
 - **I**ntegrated **M**odular **R**adio
 - **I**ntegrated **A**ntennas
 - **W**iMAX adaptation for integrated airport connectivity
 - **I**n-flight **t**rials of integrated system



FCS Action Plan 17 – Service Oriented Architecture

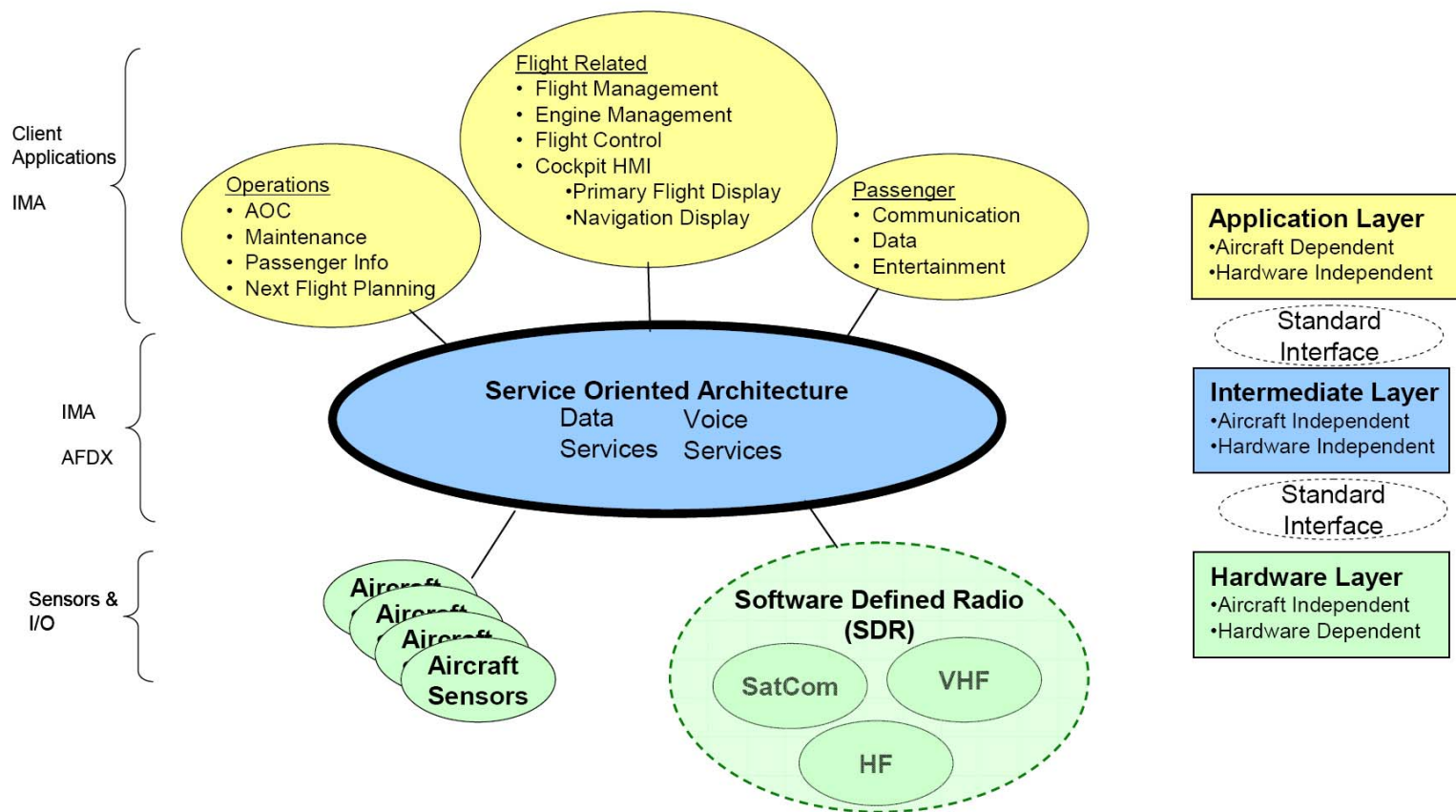


Figure 9 Service Oriented Avionics Architecture

Conclusions

- NEWSKY develops a concept and performs a preliminary system design of an **integrated aeronautical communication network** with focus on air-ground communications and IPv6 technologies
- NEWSKY specifies aeronautical networking solutions enabling **interoperability, modularity, efficient utilisation** of the overall communication system and **cost efficient operations**
- **Upcoming NEWSKY events:**
 - Stand at ATC Global 17-19 March in Amsterdam with presentation of simulation and laboratory test-bed
 - Final project event in Munich, September 2009
- More information: www.newsky-fp6.eu