Summary

DAPHNE is a project supported by the European Commission's Seventh Framework Programme to develop photonic networks and components for aircraft. The core of the project is to exploit photonic technology from terrestrial communications networks and to identify and address technology gaps in implementing photonics extensively throughout the aircraft industry. The project brings together avionic equipment and aircraft manufacturers with photonic industry members and academic network specialists.

DAPHNE started in Sep-2009 and will run for three years

- The project has fifteen partners from seven nations
- Balance of academic & research organisations with large & small industrial partners
- Project lead organisation: Airbus.

Daphne Scope

Daphne objectives will be tackled at four levels:

- **Networks**: Adapt optical network technology for aircraft platforms. A wide range of fibre optic network topologies and techniques has been developed for terrestrial systems: these will be analysed, adapted and optimised for representative aircraft platforms (large and small aircraft; rotary and fixed wing)
- **Modules**: Define a modular infrastructure for aircraft fibre optic networks. Daphne will define a scalable, modular infrastructure for aircraft photonic networks including node and interconnect concepts. A new avionic box standard will be promoted since standard avionic boxes and interfaces were designed for electronic equipment, but are not optimised for photonics.
- **Components**: Key devices and components for the Daphne infrastructure require adaptation to make them suitable for use in aircraft operational environments. Detailed requirements will include: ruggedisation for aircraft environments, compact intra-module connectors, full duplex multi-mode fibre-optic transceivers and single and multiple ribbon fibre break-out.
- **Dissemination**: The uptake of the results by industry is essential to the project success. The Daphne Advisory Group (DAG) will enable the consortium to engage relevant actors in the aerospace value chain, from component suppliers, through equipment manufacturers to end-users to ensure that a wide section of industry is given the chance to validate the concepts and solutions developed in Daphne.

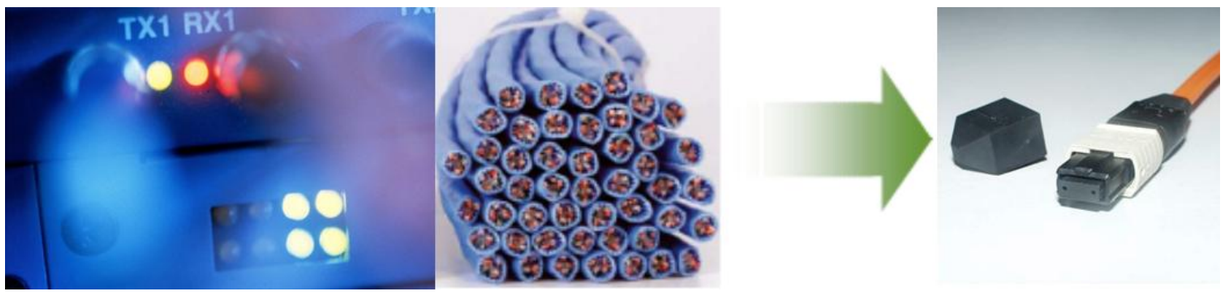
Objectives

Daphne aims to increase the use of telecoms and industrial optical networking technology in future European aircraft and systems.

Fibre optics and photonics offers obvious size, weight and bit rate advantages beyond aircraft systems state-of-the-art, but there are several other benefits:

- Excellent electromagnetic compatibility (EMC) due to the nature of the optical signal, without the need for heavy and bulky shielding.
- Increased functionality, e.g. wavelength division multiplexing (WDM), wavelength switching and optical-electrical-optical (OEO) conversion, potentially permit aircraft networks to be modular and reconfigurable.
- Hierarchical segregation: e.g. physical (multiple fibre), wavelength (single fibre) or temporal (single channel) allows novel modular network designs.

Instead of many discrete systems each with its own infrastructure, photonics allows a single network that delivers a "signal transport function" capable of supporting the channel segregation needs associated with different Design Assurance Levels (DALs, i.e., different levels of criticality) with the required quality-of-service characteristics of the channel.



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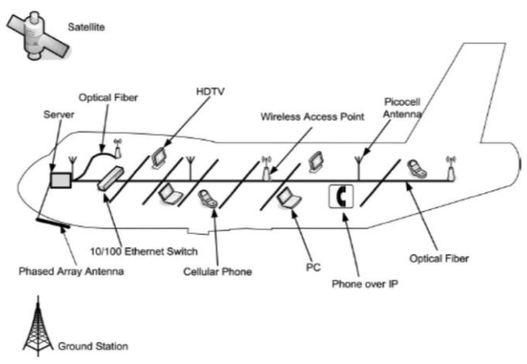
Consortium

EADS, DTU, GOOCH & HOUSEGO GROUP, SELEX GALILEO, AIRBUS, Draka, AVoptics, gmv INNOVATING SOLUTIONS, BAE SYSTEMS, ILMENAU UNIVERSITY OF TECHNOLOGY, INESCTEC TECHNOLOGY & SCIENCE | ASSOCIATE LABORATORY PORTUGAL, SQS VLÁKNOVÁ OPTIKA, AgustaWestland A Finmeccanica Company, VIVID COMPONENTS, D-Lightsys Digital & Lightwave Systems

INESTEC role within Daphne

The work carried out at INESCTEC is related with both theoretical studies, experimental performance analysis and prototype construction/demonstration, specially concerning radio-frequency-over-fibre (RoF) transmission.

Motivation for RF-over-Fibre

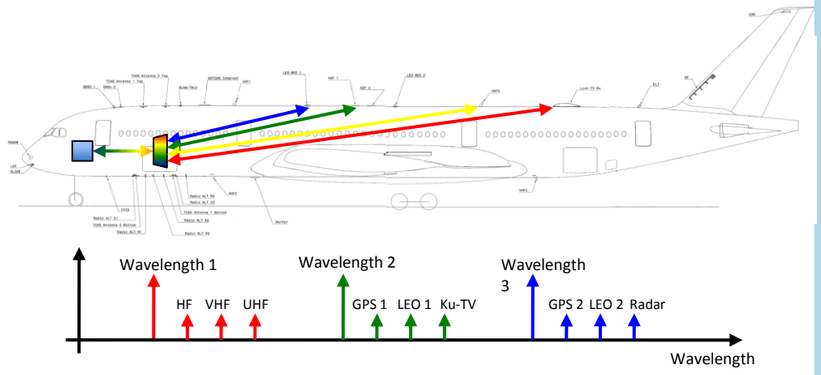


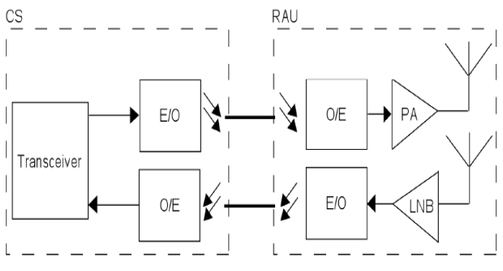
Avoid cumbersome dedicated radio frequency (RF) cabling:

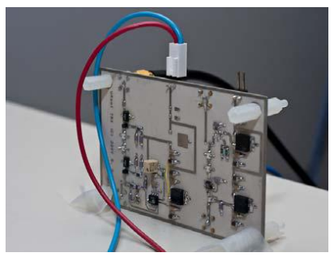
- Use the airplane optical network to transport radio signals;
- Provide to access from external antennas to transceivers installed in the cockpit and avionic bay;
- Provide wireless entertainment access to passengers.

Users want connectivity for their devices:

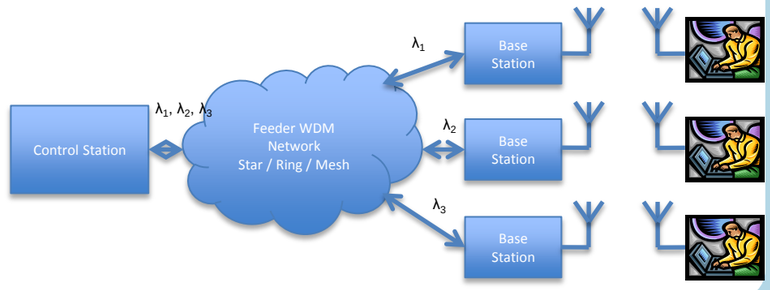
- Provide wireless access points instead of fixed seat access points;
- Reduce costs by aggregating users and reducing network access points;
- Use Radio-over-Fibre (RoF) technology to provide a transparent future proof wireless access network.







- Modulated signal is generated at the central station (CS) in a RF band and is transported through fibre to the remote antenna unit (RAU) where it is converted to the electric domain and directly transmitted to the antenna.
- This allows for centralization of complex components at the central station, with consequent simplification of remote units having low power consumption, as well as reduce maintenance costs.



INESTEC main activities

- Theoretical studies regarding the performance of wireless services supported in different fibre network topologies, namely Ultra-Wide-Band (UWB) and Wi-Fi.
- Theoretical analysis of the performance of different modulation formats.
- Development of analytical models for direct modulation (VCSEL based) and external modulation (EAM based) based optical networks, including noise, and nonlinearities from intermodulation distortion and clipping.
- System performance assessment using developed analytical modulation models, and its comparison to numerical simulations.
- Experimental performance assessment for both UWB and Wi-Fi based RoF networks, and its comparison to analytical/numerical results.
- Investigation of novel techniques for digitized radio using delta-sigma modulation.
- Development of novel techniques for fault location for passive optical networks in the context of Daphne optical network.