

OPTO-PYROTECHNICAL TECHNOLOGY FOR SPACE APPLICATIONS

Problem Statement for Launch Vehicles
October 5 & 6th, 2005

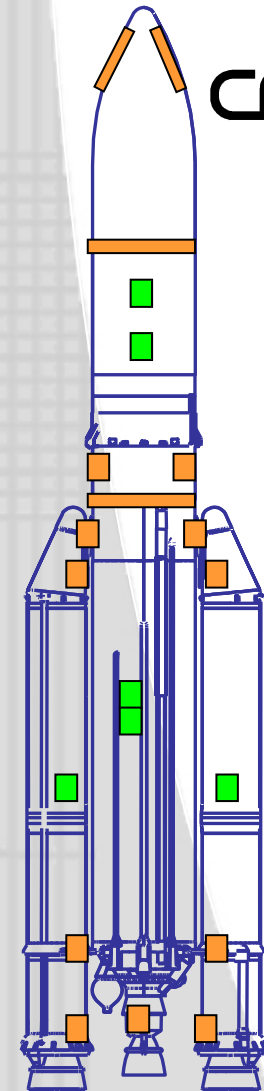
Pyrotechnical Subsystem on Ariane 5 (1/3)

Current status

- ❑ The current A5 ECA configuration includes:
 - 369 pyrotechnical devices (including 515 meters of pyro-transmission line) – this number would noticeably decrease thanks to opto-pyro technology
 - 79 final functions to be activated which shall remain unchanged

- ❑ The safeguard rules require two independant subsystems:
 - One dedicated to neutralisation ■
 - One for functional and operational needs ■

- ⚠ Compliance with current safeguard requirements is still to be achieved through dedicated studies, which could direct the architecture selection



Pyrotechnical Subsystem on Ariane 5 (2/3)

Current status (cont'd)

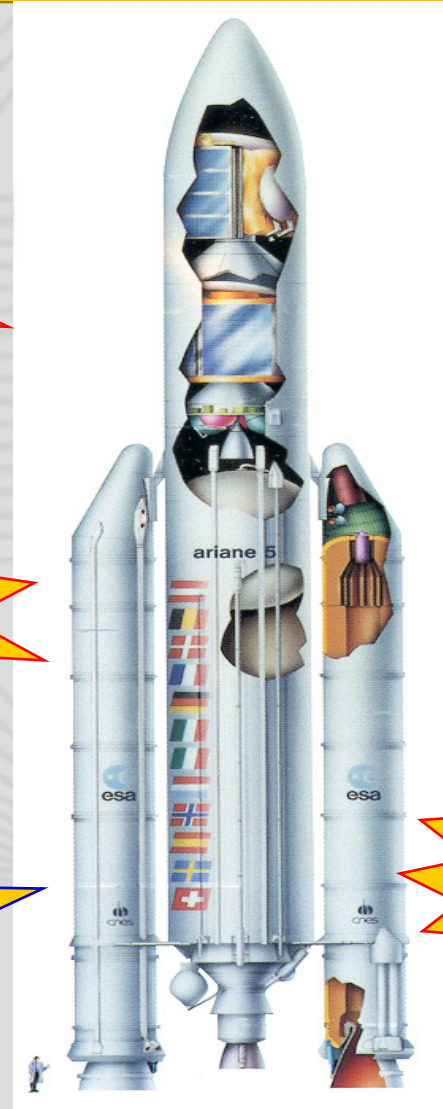
515 meters of
pyro transmission cords
over 189 lines

34 detonators

17 Arming
& Safety
Devices

36 IFOC

30 RMV



BSA: Boîtier de Sécurité et d'Armement (Safe & Arm Box)

RMV: Relais MultiVoies (MultiPath Relays)

IFOC: Inflammateur à Fonctionnement par Onde de Choc (Detonation to Deflagration Initiator)

Pyrotechnical Subsystem on Ariane 5 (3/3)

Objectives / Advantages



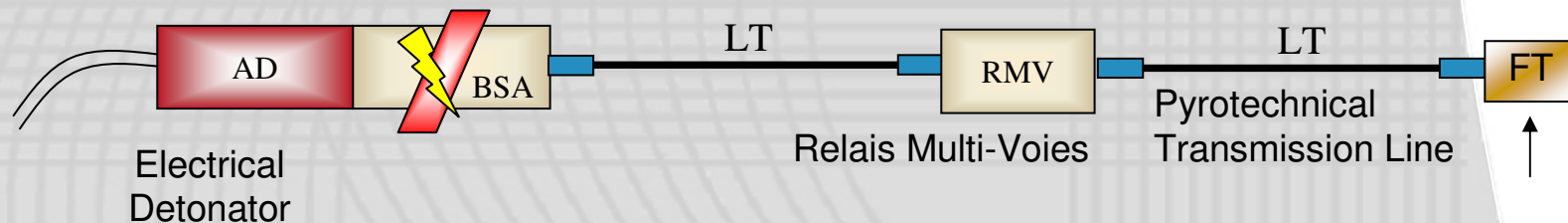
- ❑ Main objectives associated with Optopyrotechnics
 - Recurring Cost reduction (at both system and pyro-subsystem levels)
 - ↳ Only a *technological breakthrough* can bring about new cost savings (removal of pyrocords, multipath relays,...)
 - RAMS :
 - Removal of primary explosives from the system
 - should lead to decrease the dangerousness at system level (after demonstration of security requirements)
 - should simplify the last operations (**additional cost saving**)
 - Immunity to Electro-Magnetic Interference (EMI) and Electrical Static Discharge (ESD)
 - increase the safety
 - Mass reduction

Optopyrotechnical Subsystem (1/3)

Principle

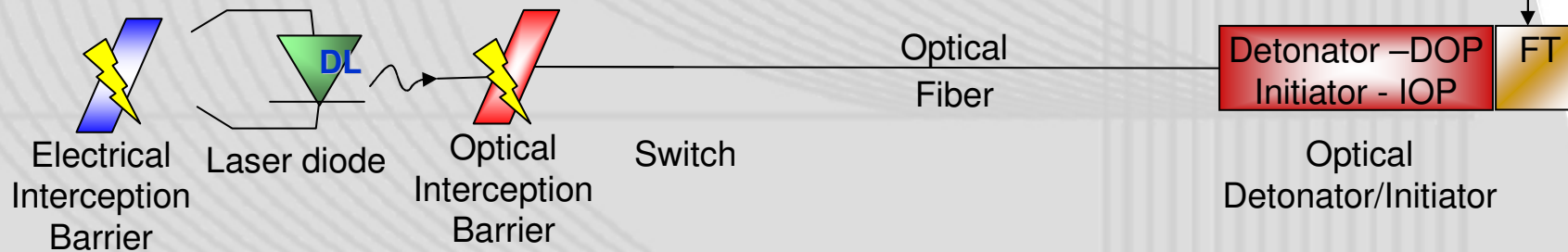
- The optopyrotechnics project consists in replacing the current electro-pyrotechnical chains by electro-opto-pyrotechnical chains

Electro-pyrotechnical elementary chain



Final function
(Fonction Terminale)

(Electro-)opto-pyrotechnical elementary chain



or

Optopyrotechnical Subsystem (2/3)

Major concerns



- ❑ The major concern of the opto-pyro technology is **Optical Power Transmission** through FiberOptic
 - which is somewhat different from the well-known **Optical Data Transmission**
- ➔ • Optical Data Transmission has been mastered for years in aeronautics:
 - Basic rules such as routing, ...remain valid for Power application
 - Space environment may be more severe (in particular launch vehicles)
- Optical Power Transmission raises new problems still to be solved
- ❑ More over, compliance of components, specially optical ones, with harsh environment is not assessed

Optopyrotechnical Subsystem (3/3)

Problem Statement



➤ Moving from electro-pyrotechnics to opto-pyrotechnics has several impacts:

- « visible » at Stages level:

- Layout
- Pyrotechnics sub-system simplification,...

- less « visible », at System level:

- Transient phases studies for control of Stages separation (and ignition): simultaneity of commands
- Fulfilling Safeguard requirements
- Impacts on On-Board Flight S/W which manages Ordnance commands

↳ Switching toward optopyrotechnic is not only a technological step, but also impacts system aspects:

- overall design, manufacturing, testability and AIT (Assembly Integration Test) process from the early beginning