Packaging of Future Integrated Modular Electronics

PRIMAE

Small or medium Focused Research Project
Project n°265413-Primae

Start Date : November 2010
Duration : 48 months

WORK PACKAGE 6000 : Packaging selection / Management

DELIVERABLE D62

Final report

Due date : T_0+48

Submission date : T_0+.48.

Lead contractor for this deliverable: THALES AVIONICS (THAV)

Dissemination level: PU – Public

WORK PACKAGE 6000 : Packaging selection / Management

WE6200

Final report

PARTNERS ORGANISATION APPROVAL

	Name	Function	Date	Signature
Prepared by:	Damien CHALAVOUX	Engineer of study and packaging development	19/12/14	
Prepared by:	Philippe OCONTE	Packaging engineer and thermal	19/12/14	
Approved by:	Claude SARNO	Business manager mechanical packaging	19/12/14	

WP MANAGEMENT TEAM APPROVAL

	Entity	Name	Date	Signature
Approved by:	THAV			
Approved by:	AOS			
Approved by:	ALA			
Approved by:	DAv			
Approved by:	DAs			
Approved by:	KTR			
Approved by:	UoP			
Approved by:	INSA			
Approved by:	ITP			
Approved by:	AALTO			
Approved by:	DTC			
Approved by:	TE			
Approved by:	RAD			
Approved by:	VZLU			
Approved by:	DAU			
Approved by:	ATM			
Approved by:	EMCC			
Approved by:	LAT			
Approved by:	CEL			
Approved by:	BAE			

CHANGE RECORD SHEET

REVISION LETTER	DATE	PAGE NUMBER	DESCRIPTION

FINAL REPORT

Grant Agreement number: 265413

Project acronym: PRIMAE

Project title: "Packaging of future Integrated ModulAr Electronics"

Funding Scheme: Collaborative Project

Date of latest version of Annex I against which the assessment will be made:

Periodic report: 1st ☐ 2nd ☐ 3rd ■ 4th ☐

Period covered: from 18st November 2010 to 31st October 2014

Name, title and organisation of the scientific representative of the project's coordinator[1]: Claude SARNO, PRIMAE Coordinator, Thales Avionics

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Project website[2] address: http://www.primae.org/

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement .
[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Declaration by the scientific representative of the project coordinator

I, as scientific representative of the coordinator of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate)[3]:

  ☐ has fully achieved its objectives and technical goals for the period;

  ■ has achieved most of its objectives and technical goals for the period with relatively minor deviations.

  ☐ has failed to achieve critical objectives and/or is not at all on schedule.

- The public website, if applicable

  ■ is up to date

  ☐ is not up to date

- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 3.4) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 3.2.3 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator: **Claude SARNO**

Date: 31 / 09 / 2014

For most of the projects, the signature of this declaration could be done directly via the IT reporting tool through an adapted IT mechanism.

[3] If either of these boxes below is ticked, the report should reflect these and any remedial actions taken.

CONTENTS

TABLE OF PICTURES

1 INTRODUCTION

This report constitutes the final report of the PRIMAE project and makes a review of the result achieved of the management issues, project activities and results achievement in the frame of the study.

Project summary

Affordable transport for the citizen relies on innovative solutions and technologies that will result in lower costs and lead-time of the aircraft and its systems. In this area, the packaging of on-board computers is an important contributor.

The Packaging of futuRe Integrated ModulAr Electronics (PRIMAE) objective is to develop a new flexible, robust and open aeronautical packaging for the next generation of electronics and particularly to Integrated Modular Avionics. This new concept after standardization will be able to replace the 35 year old ARINC 600 standard.

PRIMAE technical objectives are:
- Reduce electronics packaging in terms of volume and weight and offer flexibility and growth capability
- Reduce costs using market standard components
- Enhance reliability through thermal and vibratory breakthrough
- Mitigate EMC protection penalties in composite fuselage environment
- Ensure fast production ramp up and support rapid final assembly on aircraft
- Improve availability and reduce maintenance cost.

In these domains significant technological studies, beyond the state of the art (cooling, lightweight composite materials, electromagnetic interferences, power supply, connectivity), will be carried out in respect to airworthiness regulations.

To achieve the PRIMAE objectives, 3 steps are required:
- Definition phase of air framers and suppliers requirement
- Research and evaluation of advanced packaging technologies
- Specification and development of representative mock-up to integrate different technologies.

The concept once harmonized among the main European players participating in this project, will be proposed as a standard for the future generation of large and regional aircraft, and helicopters.
The new packaging concept will strengthen competitiveness of the market and will support the effort of industrial avionics suppliers to improve costs and environmental impacts.

2 OBJECTIVES OF THE PROJECT

The overall objective of the PRIMAE project is to develop a **robust open worldwide packaging standard** able to replace the current ARINC 600 standard.
The PRIMAE concept approach is **"Modular Integrated Packaging" (MIP)** offering the same standard in the form of a mechanical **packaging toolbox** able to support the following functional modules:

– High power: core processing, mass memory, video, graphics, power supply…
– Low power: remote core processing, network switches…
– I/O intensive: Input /Output data concentrator and gateway
– High emissive: Radio frequency, power supply

With versatile technologies including air & liquid cooling solutions to support large and regional aircraft needs. The packaging will have to fulfill the multi-domain requirements resulting from the breakthrough of new requirements from embedded electronics including Integrated Modular Electronics of 2nd Generation (IMA2G concepts include high electronic integration, optical physical layer, distributed architecture). These multi-level objectives are:

High-level needs:
Minimum weight, volume and cost, Technology transparency (obsolescence), Interchange-ability, Manufacturability, Modularity/configurability, Re-usability, Growth Capability, Maintainability, Fault Tolerance

PRIMAE technical objectives: The quantified objectives are

- Improved integration capabilities in term of Volume **(50%)**, Weight (**30%** by use of innovative structure combined with composite shielded materials)
- Compatibility with standard electronic boards & components (e.g. new high speed CPU) to reduce costs (**20%**)
- Enhanced thermal management to reduce the junction temperature (**10 °C**) which leads to an improvement of reliability of **50%**
- Reduced component failures by limiting the vibration levels (reduction of sensibility factor of **30%**) and improvement of locking and damping mechanisms
- Limit EMI (Electro Magnetic Interference) constraint of the new carbon composite fuselage on electronics and connectors (at least equivalent to current technologies)
- Ensure fast production ramp up and fast assembly line production thanks to higher pre integration, test simplicity and health monitoring
- Improve availability and reduce maintenance cost
- Improved modularity by improving the form factor and connection capabilities

PRIMAE Scientific objectives correspond to domains where **significant research and studies have to be performed** before making any decision on standardization, these fields are:

- The identification and evaluation of **new cooling** techniques capable of providing a solution to the heat dissipation problems raised by the introduction of the latest processors and dissipative components. The module average heat dissipation should increase from 20W to more than 60W for the next generation IMA2G Line Replaceable Module (LRM) and more importantly the local hot spot and heat density generated should increase from 10W/cm² to >30W/cm² (chip level). These values of heat dissipation and heat densities **are no longer compatible with the existing cooling system**, and with the requirement of LOC (Loss of Cooling) conditions, i.e., maintain operational conditions at 55° during 30min. The cooling efficiency shall be compliant with the use of components available in the industrial and automotive industries.
- The **mechanical optimization** of the racks and LRM in terms of integration as well as weight reduction, here, the use of **composite materials** will be investigated. These materials are already widely used in aircraft structures but the specific requirements of electronic housings do not permit a simple transition of these techniques. This is mainly due to electromagnetic shielding, and the electrical continuity, which has to be maintained between any two points of the structure (10 mΩ under 10 Amp). All these characteristics have to be achieved with very thin walled structures (1.5 to 2mm thick) with enough stiffness to prevent vibrations in the operational range of aircraft mechanical frequencies.

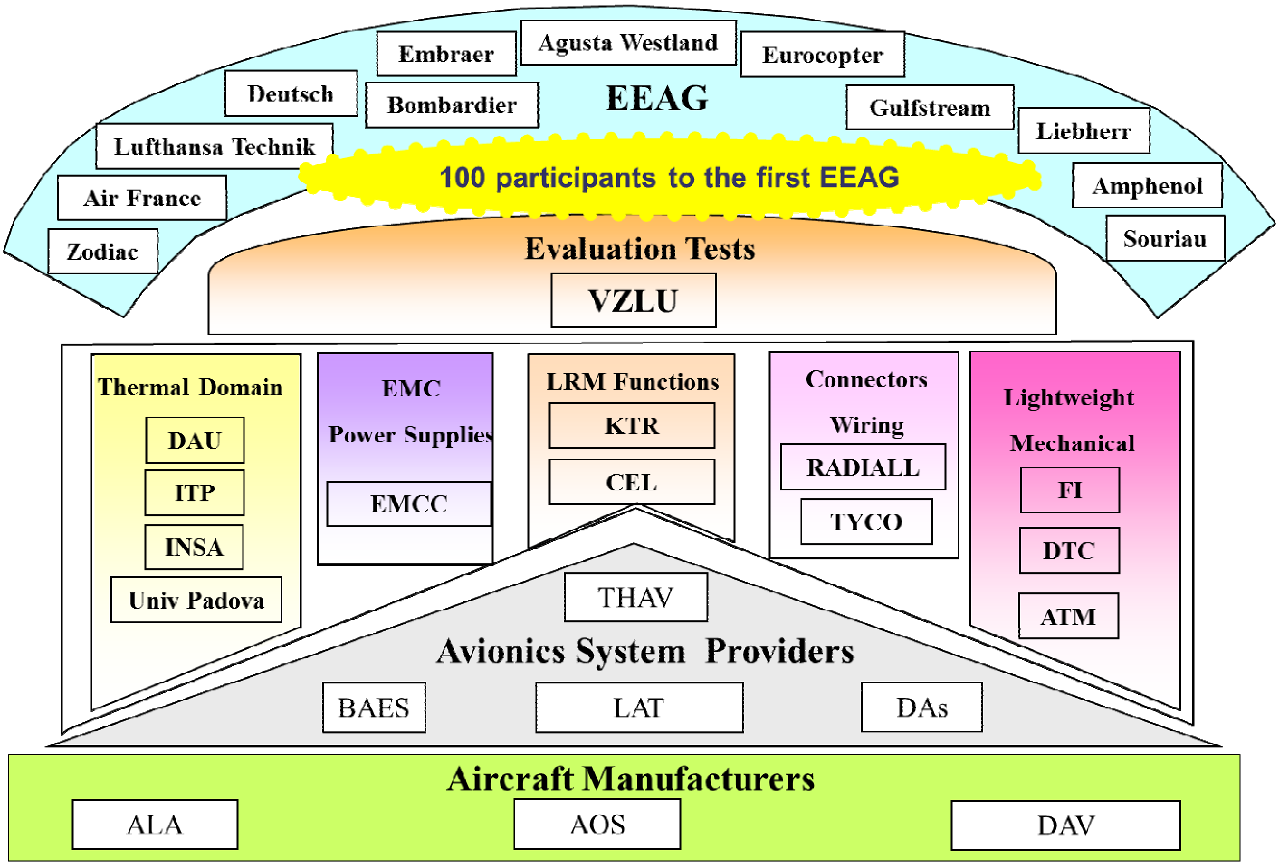
- **EMC**: Due to the proposed modification of the module layout within the avionics bays and the properties of the material composing the structure of both aircraft and the bay itself, minimization of the Electromagnetic Coupling effects is critical in order to prevent electromagnetic cross contamination between modules. Both radiated and conducted aspects of EMC require close examination in this new environment. Three aspects of EMC shielding will be considered:
  - External shielding of the rack in case of composite materials
  - Intra bay and inter module shielding
  - **Incremental qualification** of cabinet based on standard definition

3 CONSORTIUM

The PRIMAE consortium composition is shown in the next graphic. It has been built around major partners in Europe, each being among the most experienced in their domain. It includes industrial companies (large as well as SME), research centres, and universities. This has ensured greater relevance and a high innovation level for the project results. The balance between Industry and Research community ensures that the transfer of knowledge and experience from one to the other will be efficient.

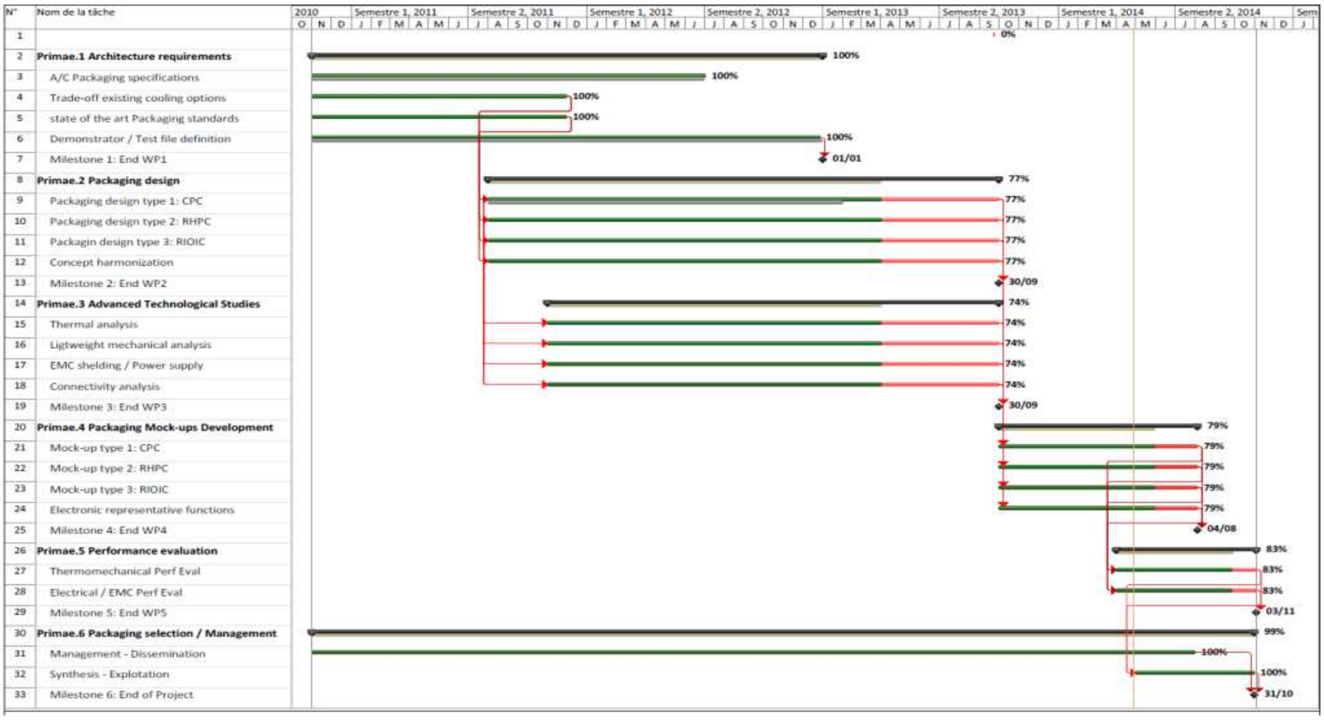
Ten countries of the European Union (France, Germany, United Kingdom, Netherlands, Italy, Finland, Czech Republic, Austria, Poland, Spain) and **an International Co-operation Partner Country (ICPC), Russia**, are represented. As can be seen above, PRIMAE groups all categories of partners required to make it successful and to guarantee effective exploitation of its results, this is particularly important addressing the establishment of a new standard.

The broad-ranging complementary capabilities of the participants and the involvement of the main aerospace players are perceived as a precious asset to guarantee the quality of the future solutions and a good coverage of the needs as well as a worldwide application of the results and support to the future standard. This team covers all identified technological study needs, with a balance between the different categories that reflects the expected, respective roles that the partners have played in the project.



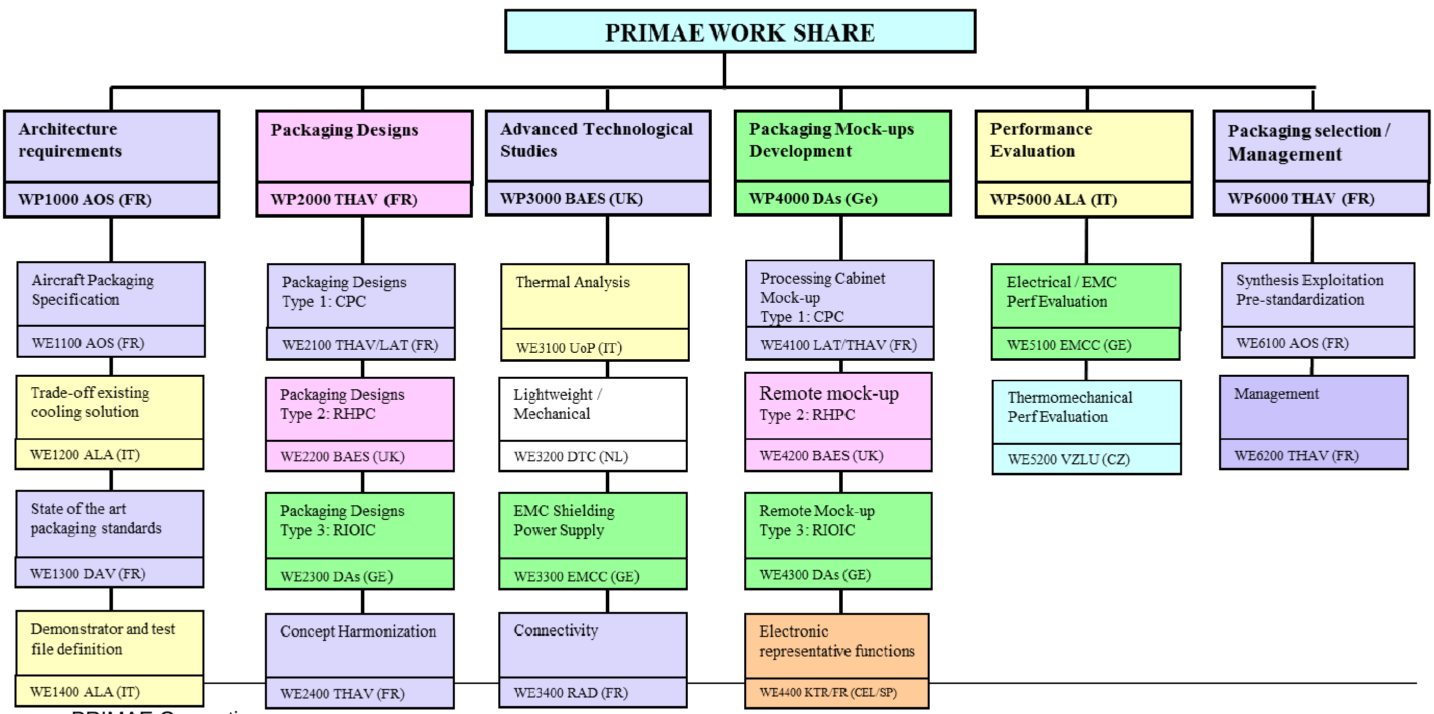
4 PROJECT PLANNING

The project duration originally planned on 42 months was extended to 48 months due to the difficulties encountered in the connection harmonization.



5 PROJECT WORK SHARE

The project work share was well balanced and each country could express its needs, requirements and participate to the final demonstration.



6 DELIVRABLES

Deliverable N°	Deliverable name	WP n°	Nature [4]	Dissemination level[5]	Delivery date (months)	Status
D11	Technical report on aircraft packaging specifications	WE11	R	PU	T0+12 M	Delivered
D12	Technical report existing cooling options	WE12	R	PU	T0+12 M	Delivered
D13	Technical report on existing packaging standards	WE13	R	PU	T0+12 M	Delivered
D14	Technical report on demonstration and test file	WE14	R	PU	T0+12 M	Delivered
D21	Technical report on packaging design PRIMAE type 1	WE21	R	PU	T0+24 M	Delivered
D22	Technical report on packaging design PRIMAE type 2	WE22	R	PU	T0+24 M	Delivered
D23	Technical report on packaging design PRIMAE type 3	WE23	R	PU	T0+24 M	Delivered
D24	Technical report on concept harmonization	WE24	R	PU	T0+27 M	Delivered
D31	Technical report on thermal analysis	WE31	R,D	PP	T0+24 M	Delivered
D32	Technical report on lightweight/ mechanical aspects	WE32	R,D	PP	T0+24 M	Delivered
D33	Technical report on EMC/ power supply	WE33	R,D	PU	T0+24 M	Delivered
D34	Technical report on wiring / connectivity	WE34	R,D	PU	T0+24 M	Delivered
D41	Technical report and physical mock-up on packaging design 1	WE41	R,D	PU	T0+42 M	Delivered
D42	Technical report and physical mock-up on packaging design 2	WE42	R,D	PU	T0+42 M	Delivered
D43	Technical report and physical mock-up on packaging design 3	WE43	R,D	PU	T0+42 M	Delivered

D44	Technical report on design of test modules and test modules	WE44	R,D	PU	T0+42 M	Delivered
D51	Technical report on electrical/ EMC performance evaluation	WE51	R,D	PU	T0+48 M	Delivered
D52	Technical report on thermo mechanical performance evaluation	WE52	R,D	PU	T0+48 M	Delivered
D61	Technical report on synthesis,	WE61	R	PU	T0+48 M	Delivered
D62	Final reports, six monthly and annual management reports dissemination, pre standardization	WE62	R	PU	T0+48 M	Delivered

7 MEETINGS

Two types of meeting were planned:
Official international reviews every 6 month and technical meetings as often as necessary to achieve the technical goals.

- First, there are some official meetings:

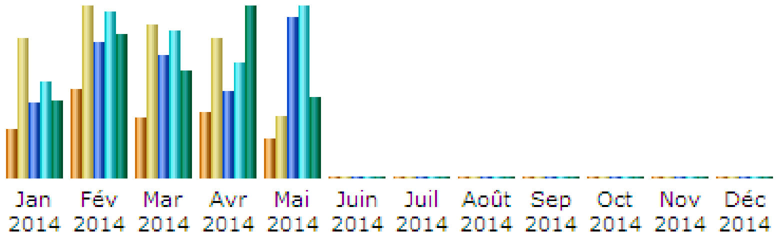
DATE	MEETING NATURE	PLACE	RESPONSIBLE
19/11/2010	KICK OFF	VALENCE (FR)	THAV
T_0 + 6	WP 1000 IN PROGESS	ITALY	ALA
T_0 + 12	WP 1000 COMPLETED WP 2000 IN PROGRESS	TOULOUSE (FR)	AOS
T_0 + 17	EEAG	VALENCE (FR)	THAV
T_0 + 18	WP 2000 IN PROGRESS WP 3000 IN PROGRESS	ENGLAND	BASE
T_0 + 24	MID TERM REVIEW	NETHERLANDS	DTC
T_0 + 34	WP 4000 IN PROGRESS	GERMANY	DIEHL
T_0 + 42	WP 4000 IN COMPLETED WP 5000 IN PROGRESS	CZECH REPUBLIC	VZLU
T_0 + 43	EEAG	VALENCE (FR)	THAV
T_0 + 48	FINAL REVIEW	FRANCE	THALES

WE1100	Aircraft packaging specification	Webex 1 KOM WE1100 14th March 2011	Webex 2 28th March 2011	Webex 3 18th April 2011	Webex 4 20th June 2011	Webex 5 5th August 2011	Webex 6 7th October 2011	Webex 7 14th December 2011	Meeting 1 29th March 2012						
WE1200	Trade -off existing cooling solutions	Audio 1 KOM WE 1200 22nd December 2010	Audio 2 31 st January 2011	Audio 4 22nd april 2011	Audio 4 12th May 2011	Audio 5 9th September 2011	Audio6 27th October 2011								
WE1300	State of the Art of Packaging standards	Audio 1 KOM WE 1300 4th February 2011	Audio 2 23rt March 2011	Audio 3 31st May 2011	Audio 4 17th June 2011										
WE 1400	Mocks-ups and test file definition	Audio 1 KOM WE 1400 2nd March 2011	Audio 2 28th September 2011												
WE2100	Packaging Design Type 1	Webex 1 KOM WE2100 2nd November 2011	Audio 11th January 2012	Meeting 1 LAT/ THAV - Valence 21st February 2012	Meeting 2 THAV/ LAT - Valence 9th March 2013	Audio 2 THAV / LAT 11th June 2012									
WE2200	Packaging Design Type 2	Webex 1 KOM WE2200 7th November 2011	Audio THAV / BAE 6th June 2012	Audio 2 BAE/ THAV 13th June 2012											
WE2300	Packaging Design Type 3	Webex 1 KOM WE2300 9th February 2012	Audio THAV / DAs 12th June 2012												
WE2400	Concept Harmonization	Audio 1 with RAD 30rd January 2012	Meeting 1 with TE 28 February 2012	Audio with TE 28th February 2012	Audio 3 with RAD 06th March 2012	Audio 4 with TE 12th March 2012	Audio 5 with TE 11th April 2012	Audio 6 with TE 10th May 2012	Audio THAV/RAD 13th March 2013	Audio THAV/RAD/TE/ DAV/AOS Das 21st March 2013	Meeting THAV/RAD/DAV/ Das/TE/AOS/BAE 14th May 2013	Meeting THAV/RAD/DA V/Das/TE/AOS /BAE 25th June 2013	Audio THAV/BAE/D AS 24th July 2013	Audio THAV/KT R/BAE/D as/AOS/ ALA/DA V/TE/RA D/LAT 13th Septemb er 2013
									Meeting THAV/KTR - Valence 17th January 2013	Audio THAV/KTR 12th March 2013	Meeting THAV/KTR - Toulon 21st May 2013	Audio THAV/KTR/BA E/Das 31st July 2013	Audio THAV/KTR/B AE/Das/AOS/ ALA/DAV/TE/ RAD/LAT 29th August 2013	
W3100	Thermal Analysis	Audio 1 KOM WE3100 11th January 2012	Audio 2 31st May 2012												
WE3200	Lightweight / Mechanical	Audio 1 KOM WE3200 11th January 2012													
WE3300	EMC Shielding / Power Supply	Audio 1 KOM WE3300 11th January 2012													
WE3400	Connectivity	Audio 1 KOM WE3300 11th January 2012	Meeting 1 RAD - Château-Renault 31st January 2012												
WE4100	Manufactruring design Type 1	Audio THAV/LAT 26th November 2013	Audio THAV/LAT 10th December 2013	Audio THAV/LAT 17th December 2013	Audio THAV/LAT 07th February 2014	Audio THAV/LAT 10th March 2014	Audio THAV/LAT 08th April 2014								
WE4200	Manufactruring design Type 2														
WE4300	Manufacturing design Type 3														
WE4400	Electronics representative functions	Audio 1 THAV/KTR 10th October 2013	Audio 2 THAV/KTR 19th December 2013	Audio 3 THAV/KTR 06th February 2014	Audio 4 THAV/KTR 07th March 2014										
WE5000	Performance evaluation	Audio 1 THAV/KTR/CEL 2nd February 2014	Audio 2 THAV/KTR 7th March 2014	Audio 3 THAV/KTR/RA16th July 2014											
WE6000	Packaging selection / Management	Audio THAV/KTR/BAE /Das/AOS/RAD/ LAT/CEL/VZLU 12th March 2014													

8 DISSEMINATION

PRIMAE WEBSITE: ***www.primae.org***

Historique mensuel



Mois	Visiteurs différents	Visites	Pages	Hits	Bande passante
Jan 2014	756	2172	31047	39493	460.41 Mo
Fév 2014	1378	2673	55647	67853	855.02 Mo
Mar 2014	926	2397	50443	60273	640.09 Mo
Avr 2014	1026	2196	35334	47057	1019.61 Mo
Mai 2014	613	965	65718	70001	480.12 Mo
Juin 2014	0	0	0	0	0
Juil 2014	0	0	0	0	0
Août 2014	0	0	0	0	0
Sep 2014	0	0	0	0	0
Oct 2014	0	0	0	0	0
Nov 2014	0	0	0	0	0
Déc 2014	0	0	0	0	0
Total	4699	10403	238189	284677	3.37 Go

The website attracted interest and was visited more than 1000 times per month of it highest rate.

PRIMAE presentations thought conferences and work-shops:

PRIMAE EEAG meeting, Valence, (March 29-30, 2012)
IHPC, Lyon, (May, 2012) International Heat Pipe Conference
IHPC, Kanpur, (October, 2013) International Heat Pipe Conference
AEEC (SAI) Subcommittee meeting, Frankfurt, (June 27-28, 2012) Systems Architecture and Interfaces
IMAPS, 8th European Advanced Technology Workshop on micro packaging and Thermal management (La Rochelle - 6, 7 February 2013)

“**Entretiens de Toulouse**” (23, 24 april 2013) Equipment packaging: the need for radical changes (Thales)
IMAPS, 9th European Advanced Technology Workshop on micro packaging and Thermal management (La Rochelle - 6, 7 February 2014)

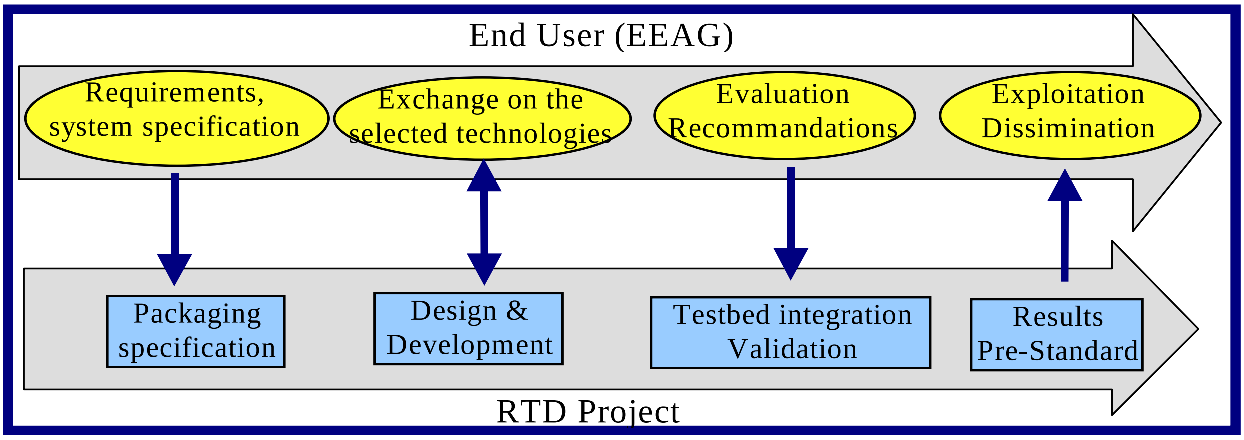
<u>Publication</u>

R. Hodot, , C. Sarno, B. TRUFFART, Vincent POMME, J. Coulloux, C. Zilio, S. MANCIN, Electronic cooling for avionics using loop heat pipes and mini-Vapour Cycle Systems, IMAPS, La Rochelle, France, February 4-5, 2015

R. Hodot, V. Sartre, J. Coulloux, C. Sarno Electornic cooling for avionics using loop heat pipe with cylindrical evaporator, IMAPS, La Rochelle, France, February 6-7, 2014
S. Safouene, T. Barreteau, V. Sartre, R. Hodot, Experimental comparison of loop heat pipes performance with various evaporator designs, 17th International Heat Pipe Conference, Kanpur, India, October 13-17, 2013, 6 p.
R. Hodot, V. Sartre, F. Lefevre, C. Sarno, 3D modeling and optimization of a loop heat pipe evaporator,17th International Heat Pipe Conference, Kanpur, India, October 13-17, 2013, 6 p.
R. Hodot, Loop heat pipes for the thermal management of hot spots in future electronic equipments, IMAPS, La Rochelle, France, February 6-7, 2013
C. Sarno, C. Tantolin, R. Hodot, Y. Maydanik, S. Vershinin, Loop Thermosyphons for the thermal management of an aircraft electronic box, 16th International Heat Pipe Conference, Lyon, France, May 20-24, 2012, 6 p.

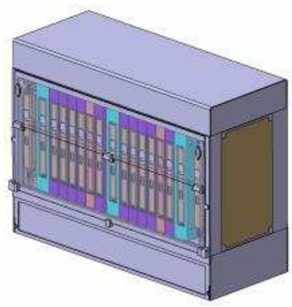
9 EEAG

The External Experts Advisory Group (EEAG) objective is to provide input constraints and requirements and also to facilitate the acceptance of this new proposed standard in the avionics and equipment world to enlarge the base of the future Standard to a wider community of users outside Europe and worldwide
The EEAG is composed of end–users (Airlines, aircraft manufacturers, equipment’s manufacturers, component providers…) and will interact with the project.



Two EEAG Work shop have been organised during the life of the project.

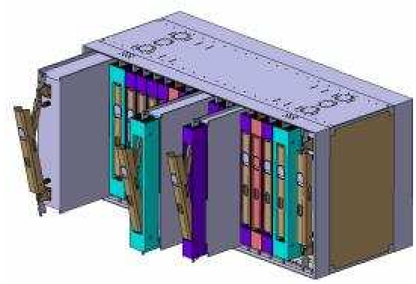
- **The first EEAG work shop was held in Valence at T0+17**:



A Workshop concerning the PRIMAE project has taken place in Valence, on the 29th - 30th March 2012.

The workshop has been successful with about 100 participants coming from 44 companies through 10 countries.

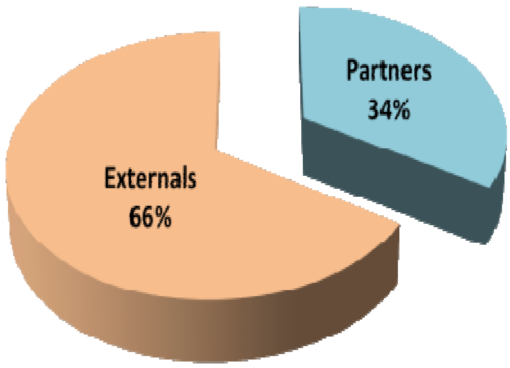
PRIMAE project has been launched in the Frame of the FP7 call N°3 concerning the Aeronautics and Transport by the main players of the domain (Airframers and Equipment Manufacturers). The goal of this project is to establish a new standard able to replace the 30 years old existing standard by a more modern and competitive one.

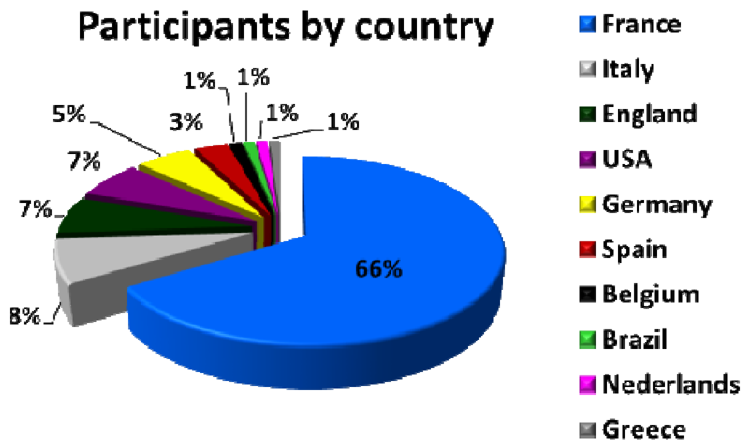


In order to define a successful concept applicable worldwide, a multidisciplinary approach has been proposed including:

- The rack architectures (module type and organization)
- The cooling management solution & architectures
- The structural and vibration aspects
- The electromagnetic shielding
- The connectors aspect (optical, Gb/s)
- The signals and power supply distribution
- The upgrade and maintenance aspects.

The goal of this workshop was to enlarge the base of the future Standard to a wider community of users outside Europe, including airlines and aircraft manufacturers.





During the work shop, Thales recalled the most important challenges, followed by an Airbus presentation of the needs and the Dassault presentation of the State of the Art, following by presentations from the partners, BAEs, DHIEL, Alenia, Radiall and Tyco with an active participation from the audience.

Exhibition booths were prepared to show latest Thales technologies including laser gyros, MEMS, power supply, Cabinet Packaging…




The workshop also continued in a festive and friendly atmosphere.

- **The second EEAG work shop took place in Valence at T0+43:**

The goal of this workshop was to enlarge the base of the future Standard to a wider community of users outside Europe, including airlines and aircraft manufacturers. It was also intended to present the results achieved and to discuss the next possible steps. The workshop has been successful with about 60 participants coming from 25 companies through 10 countries.

The PRIMAE consortium partners presented the requirements, the state of the art and the packaging issues in each domain.

Claude Sarno, project leader TAV

Anaïs Hourcade, Airbus

Pierpaolo Borelli, Alenia

Interesting points of view where exchanged with the audience (Boeing, Airbus, Embraer, Etihad, Rockwell, Airbus Helicopter, BAE…).

Matthew McAlonis, TE

The final important topic rised by the EEAG was "what's next?" and the participant agreed on:

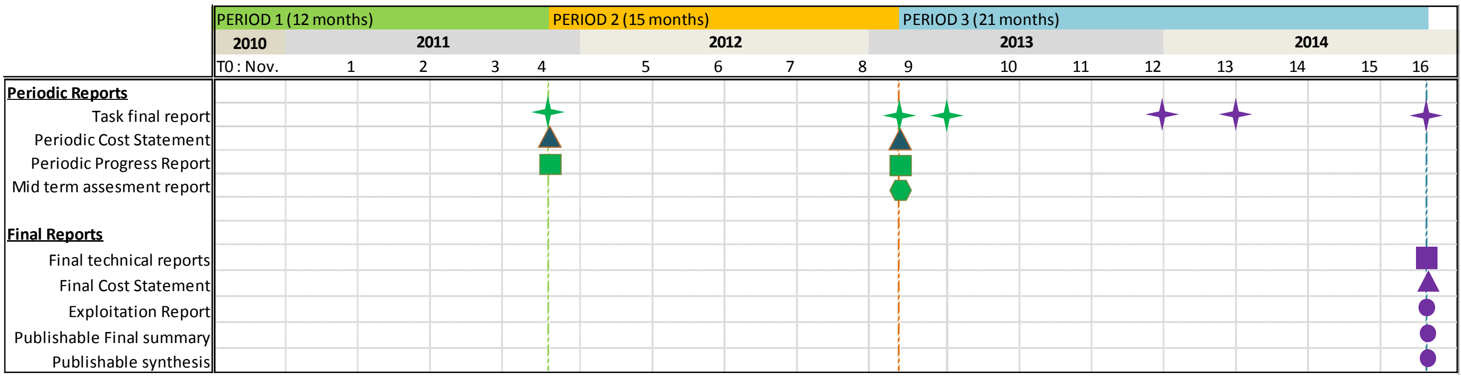
Terminate the PRIMAE evaluations positively (end 2014).

Launch the ASD-STAN standardization through the STAN D2 S11 group if a target programme is defined.

Continue the development of the PRIMAE standard either through an aircraft programme or through further R&T studies.

It is interesting to notice that the aerospace community is widely open to the establishment of an international standard particularly the US companies through a transatlantic cooperation as initiated thought this PRIMAEUS project.

10 REPORTING PERIODS



Three main reporting periods have been defined along the course of the project (T0+12, T0+27, T0+48).

11 LEGAL ASPECTS

Two amendments have been discussed and

Amendment n°1 -:

- Amendment N°1 to Grant Agreement N°2013265423 date d 7th January 2011
- Addition of a new entity
  - BAE Systems (Operations) Ltd, established in Warrick House, FARNBOROUGH, GU14 6YU.
- Modifications of Annex I – Description of Work
- Revision of Part A and B of Annex I dates 4th May 2011
- Modification of the legal entity Tyco Electronics UK ltd's details.

Amendment n°2:

- PRIMAE project is governed under :
  - Amendment N°2 to Grant Agreement N° 265413 dated 2 8th August 2013.
  - Consortium Agreement signed by Thales Avionics on 22nd July 2011.
- Main changes on the Amendment n°2 of the Grant Ag reement
  - Update of some beneficiaries organization status and authorized representatives,
  - Modification of the project duration,
  - Update of PRIMAE DOW with new schedule and milestones.

12 PRE-STANDARDIZATON

12.1 OBJECTIVES

One of the goal of the PRIMAE project is the production of a **draft standard** intended to prepare the standardization for the future avionics packaging. The synthesis document defines interfaces at module level (LRM) and rack level (LRU) and propose possible compliances with current industrial standards

Many possible steps have been foreseen **to go to an international standard:**

- The first basic one is to implement the concept resulting from the study on a new aircraft development inside manufacturers programs (Airbus, Alenia, Dassault...).
- Then, to really standardize the “PRIMAE” packaging concept, **two possibilities** are offered in ascending complexity order:
- At **the European level first**, creating an “EN” standard through the European ASD-STAN organisation. To do so, the subject must be taken into account by an ad hoc working group. The current electrical working group (C2) of the ASD-STAN organization doesn’t have such an existing sub-group for packaging aspect. The subject has been raised to the ASD-STAN board by the consortium members. The proposed option is to create a new “C2” sub-group for MOAA Modular and Open Avionics Architecture. This new working group would be linked with the current electrical connector working group C2WG3 and the current optical working group C2WG10. During the course of the PRIMAE project, the consortium has maintained contacts **with the ASD-STAN** through the members of the consortium pertaining to this committee, and has informed them on the advancement of the packaging concept, as soon as the first results were made available.
- Then the next possible step would be to standardize **it through an ARINC specification**. The ARINC (Aeronautical Radio, Incorporated) organization includes, the main international Airlines among which three were invited to the PRIMAE EEAG (Air France, Lufthansa, and Delta). A dedicated committee named AEEC deals with “Engineering Standards for Avionics and Cabin Systems”. In this AEEC committee, the subcommittee NIC specializes in “New Installation Concepts”. The existing ARINC 600 standard was worked out through the NIC subcommittee.

For new standardization projects, an APIM (ARINC Project Initiation/Modification) document should be submitted. It is to mention that the support of an Airline company for the project is highly recommended. Another important point is that the yearly work program of each ARINC committee is established during its annual meeting, consequently, the APIM document for standardization should be created and submitted early enough to the committee, and the year preceding the start of the work.

During the course of the PRIMAE project, the consortium has **been in touch with the ASD-STAN** through the members of the consortium pertaining to this committee, and informed them on the progress of the packaging concept, as soon as the first results were available, we have considered the appropriateness **of transferring these results** to the ad-hoc packaging group depending on their consistency at that time.

The draft specification document produced by this WE combined with the ASD-STAN progress results will constitute the base of a future APIM document for the ARINC, if this route is confirmed through the next PRIMAEUS program to be launched with the US on a multilateral base.

12.1.1 Arinc Activities

A contact has been established with the ARINC organisation, and a formal presentation of PRIMAE has been organised in Franckfurt in June 2012 to the AEEC Systems Architecture and Interfaces (SAI) Subcommittee

The major comment from the audience composed of the main airlines and airframers, was that to have a chance to become an international standard, PRIMAE should enlarge the base of participants and mainly the US base as the ARINC is composed in majority of US companies

After the meeting it was proposed to the PRIMAE consortium to prepare a next project called PRIMAEUS in order to involve our US counterpart including Boeing, Rockwell Collins, Honeywell.

These companies have been invited to participate to the PRIMAE EEAG workshop dedicated to external dessimination

The discussions have been very positive, and the PRIMAEUS project (extended also to other non-European countries like CHINA , Russia, Brazil, Canada) should be possibly launched when the appropriate window will appear in the H2020 project as well as the US FAA funding.

The difficulty here will be to synchronise both funding, and also with the other countries.

12.1.2 ASD-STAN Activities

An expert group among the partners has been named to prepare the harmonized draft standard
The draft has been produced and is described here after

12.2 INTRODUCTION

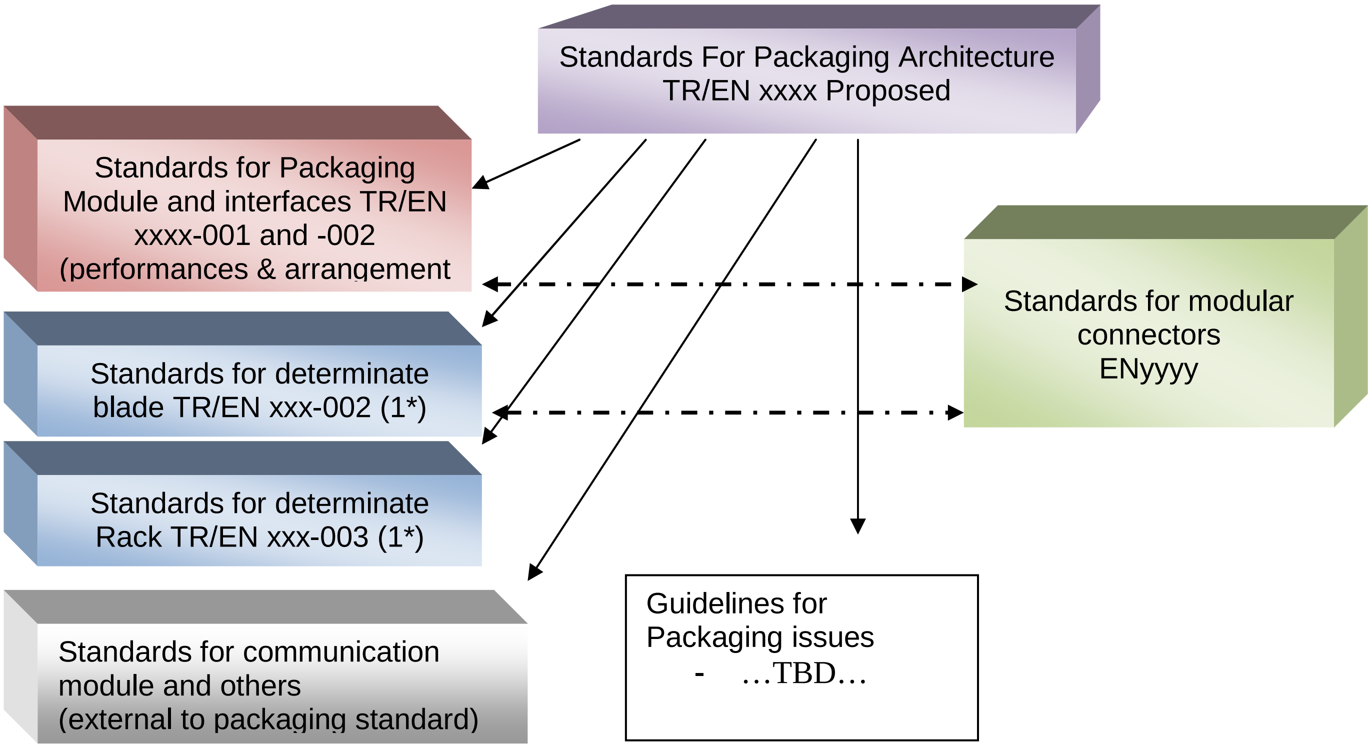
12.2.1 Purpose

The purpose of the PRIMAE Program is to define and validate a set of open Packaging Modular Architecture standards (PMA), concepts and guidelines for Packaging Modular architecture (PMA) in order to meet the main PRIMAE drivers.
The standards, concepts and guidelines produced by the Program are to be applicable to both new Aircraft and update programs.

The main drivers for the PRIMAE Program are:
– Reduced life cycle costs,
– Improved mission performance,
– Improved operational performance.

The Standards are organized as a set of documents including:
– A set of agreed standards that describe, using a top down approach, the Packaging Architecture overview to all Interfaces required implementing the core within avionics systems,
– The guidelines for system implementation through application of the standards. (TBD).

The document hierarchy is given hereafter



(1*) Standards document for "determinate blade & rack" are not includes in this proposal standard phase

Picture 1 : Standard Documentation Organization chart

12.2.2 Document Structure

The document contains the following sections:

Section 1, gives the scope of the document,
Section 2, identifies normative references,
Section 3, gives the terms, definitions and abbreviations,
Section 4, presents the set of architecture drivers and characteristics as well as an introduction to PMA,
Section 5, defines the architecture standard, and introduces the other standards,

Annex A, presents the different packaging architecture.

12.3 SCOPE

The purpose of this standard is to establish uniform requirements for the Packaging Modular Avionic (PMA) systems as defined by the PRIMAE Program.
The PMA architecture can be built by using common components. These components are specified in separate standards as modular connectors. Ways of using these components are described in a set of guidelines.

12.4 NORMATIVE REFERENCES

12.4.1 AECMA References

This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

TR/EN xxxx-002 Aerospace series - Modular and open avionics Architecture - Part 002: functional blades for Packaging avionic architecture. (Performances and arrangements,) not included in this proposal specification phase)

TR/EN xxxx-003 Aerospace series - Modular and open avionics Architecture - Part 003: functional module for Packaging avionic architecture. (Not included in this proposal specification phase)

TR/EN xxxx-004 Aerospace series - Modular and open avionics Architecture - Part 004: functional Rack for Packaging avionic architecture. (Not includes in this proposal specification phase)

EN2591-205 Aerospace series. Elements of electrical and optical connection. Test methods. Housing (shell) electrical continuity

EN 2591-315 Aerospace series. Cable, electrical, aircraft use. Test methods. Part 315. Resistance to fluids

EN3197 Aerospace series - Installation of aircraft electrical and optical interconnection systems

EN.... Aerospace series – electrical contacts crimped

EN.... Aerospace series – Opticall contacts

EN 4529-002 Aerospace series – Aerospace series - Elements of electrical and optical connection - Sealing plugs - Part 002: Index of product standards

EN tbd-002 Aerospace series - Connectors, optical, rectangular, modular, multicontact, 1,25 diameter ferrule, with removable alignment sleeve holder - Part 002: List of product standards

Pr ENyyyy-001 Aerospace series – Connectors, electrical and optical, rectangular modular – Operating temperature TBD 175℃ (or 125℃) – Part 0 01: Technical specification.

Pr ENyyyy-002 Aerospace series – Connectors, electrical and optical, rectangular modular – Operating temperature TBD 175℃ (or 125℃) – Part 002: specifications of performances and contacts arrangements

Pr ENyyyy-003 Aerospace series – Connectors, electrical and optical, rectangular modular – Operating temperature TBD 175℃ (or 125℃) continuous – Part 003: rectangular inserts and insert extraction tool – Product standard.

Pr ENyyyy-011 Aerospace series – Connectors, electrical and optical, rectangular modular – Operating temperature TBD 175℃ (or 125℃) continuous – Part 011: Male housing size .., ~~class A, C and E – Product standard.~~
Pr ENyyyy-012 Aerospace series – Connectors, electrical and optical, rectangular modular – Operating temperature TBD 175℃ (or 125℃) continuous – Part 012: Female housing size ..., ~~class A, C and E – Product standard.~~

12.4.2 Others refererence

ARINC Specification 600 Air Transport Avionics Equipment Interfaces

EUROCAE ED14 / RTCA DO160F   Environmental Conditions and test Procedures for Airborne Equipment

ISO 2669   Environmental tests for aircraft equipment -- Steady-state acceleration

12.5 TERMS, DEFINITIONS AND ABBREVIATIONS

12.5.1 Terms and definitions

Use of “shall”, “should” and “may” within the standards observe the following rules:
– The word SHALL in the text expresses a mandatory requirement of the standard.
– The word SHOULD in the text expresses a recommendation or advice on implementing such a requirement of the standard. It is expected that such recommendations or advice will be followed unless good reasons are stated for not doing so.
– The word MAY in the text expresses a permissible practice or action. It does not express a requirement of the standard.

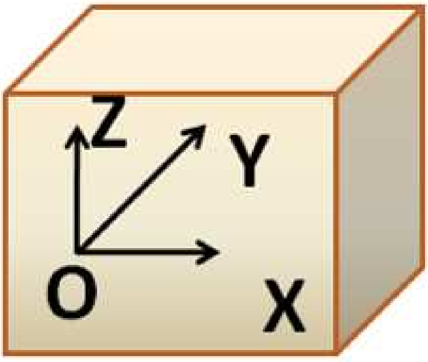
12.5.2 Abbreviations and terms

Admission plenum	
Backplane	A part of cabinet which allows all internal electrical links and support harness for direct aircraft connection part.
Blade	Individual module which includes electronics function, inserted and extractible directly from the rack (is also named LRM).
Cabinet	A complete definition of total assembly of Rack, modules, backplane, and optional devices for airflow interfaces.
Chassis	Assembly of Rack, Bakplane, ICB, and may include door, admission plenum and extraction plenum).
CPC	Core Processing Cabinet
EN	European Norm
Extraction plenum	
ICB	Interconnection Customization Box
IED	Insertion Extraction Device
PCB	Printed Circuit Board
PMA	Packaging Modular Architecture
PSM	Power Supply Module
Rack	Main mechanical structure witch can receive all sub-assembly parts and blades.
RHPC	Remote High Power Cabinet

RIOIC	Remote I/O Intensive Cabinet
TBC	To Be Confirmed
TBD	To Be Defined
XMC	Standard of electronic board in mezzanine

Picture 2 : Abbreviations and Terms table

12.5.3 Definition of axes in 3D for Blades and Cabinet



Picture 3 : 3D axis reference

12.5.4 Tables of reference axes for sizing

The objective of this table is to have a better understanding and a coherent definition of sizing between all assemblies or subassemblies (for ex : Blade, Connectors and Rack)
The reference planes and axis used in this product standard are listed below:

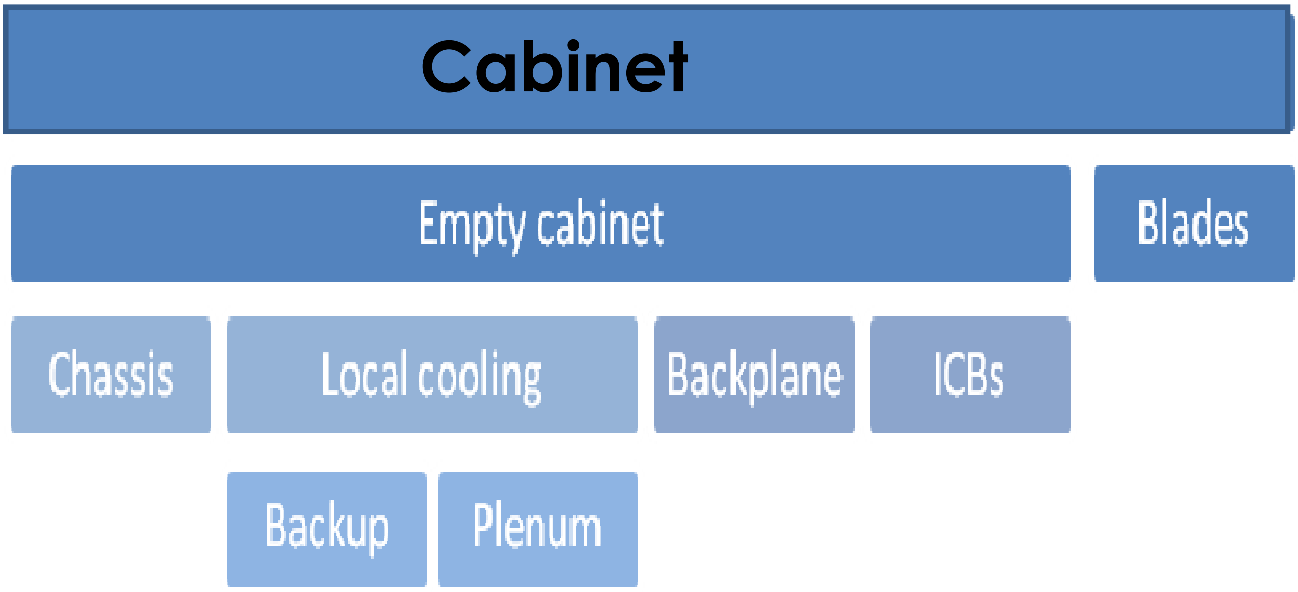
ref	axe	description	comments
A **B** **C**	**Y** **X** **Z**	mating plan between blade and Rack alignment plan between blade and Rack	Is also mating face for blade and rack interface connector and positioning blade in 3 axes
B(x)		Blade level axis category	
Ba	Z	Symmetric axes from Z blade outline	
Bb	Y	Ref mating face blade to IED	
Bc			
R(x)		Rack level axis category	
Ra	Z	Symmetry axis between the 2 rails "slide zone"	
Rb	x	Symmetry axis of bottom rail " wide side of slide zone"	
Rc	x	Symmetry axis of top rail " wide side of slide zone"	
Rd	Y	interface rack / chassis door	
C(x)		Connector level axis category	
Ca			
Cb			
D			
E			
F			
G			
H			
J			
K			
L			
M			
N			
R	Z		
S			
T			
X			
Y			
Ap	X	Connector shell bottoming reference plane on male housing	Is also ref. plane of main.PCB blade
Ar	X	connector shell bottoming reference plane on female housing	Is also ref plane of PCB backplane
Bp	Z	vertical axis of male housing	
Br	Z	vertical axis of female housing	
Cp	y	horizontal axis of male housing	
Cr	y	horizontal axis of female housing	

Picture 4 : Table of reference axis for sizing

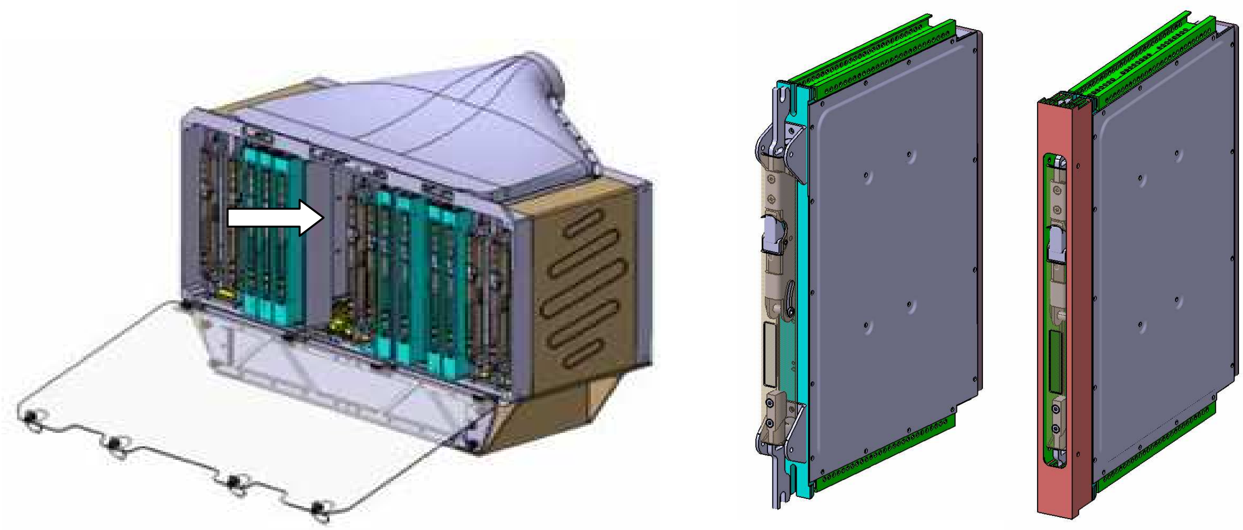
12.6 DESCRIPTION OF MODELS

Modular electrical/optical rectangular, Empty Cabinet and blade, environmental resistant, shall be defined by the final customer at the cabinet level. – Standard cabinet environment is defined in chap. 8

Blades shall be internal Cabinet connected and may be partially direct connected to aircraft with using electrical and/or optical standardized contacts.



Picture 5 : Cabinet organization



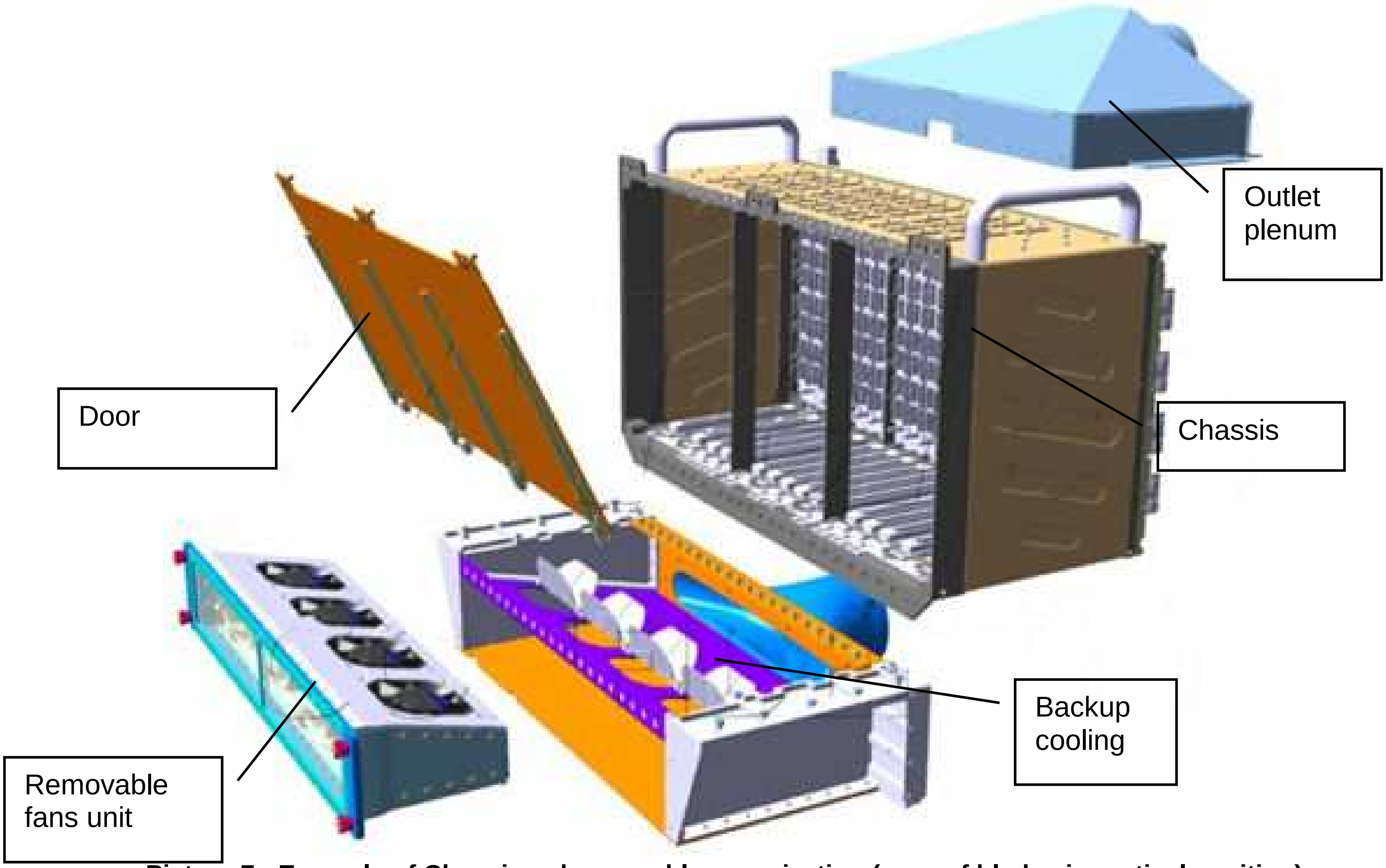
Picture 6 : Cabinet and Blades

Optional parts are defined according to aircraft interface and aircraft airflow distribution capability (inlet and outlet airflow adaptor box in interface with airflow aircraft distribution-. (not defined in this standard).

- For each case the cabinet is common: independent of the configuration and the location in the aircraft. The width can be decreased in the case of compact rack, but the manufacturing is the same.

- The backplane is specific for each configuration: the arrangement of the connectors and the type of contact are different.

- Depending on the position and the aircraft manufacturer, the plenums and the back-up cooling are specific. The back-up is removable in aircraft.



Picture 7 : Example of Chassis sub-assembly organization (case of blades in vertical position)

12.7 REQUIREMENTS AND STANDARD ARCHITECTURE OF BLADES

12.7.1 Common functional module

The blades size (external form and volume) is defined to accept a 6U outline PCB electronics circuit. It can accept too a XMC standard module in mezzanine on it.

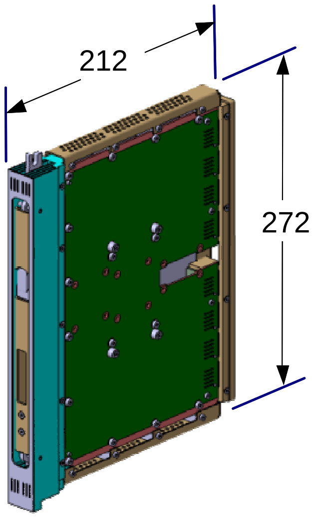
Blades are plugged directly inside a standardised slide Rack without any specific tool and adjustment.

Blades and rack conception allows in full security the correct connection by the plug and receptacle connector.

A IED system provides on the blade its retention by permanent pressure on the Rack mating face and its correct positioning by guide pins on the rack.

The cooling fluid generated by the rack through the LRM ensures itself the good flow at a given pressure.

There are 3 different blades sizes according to the type of functionality and the pitch objective in the Rack.

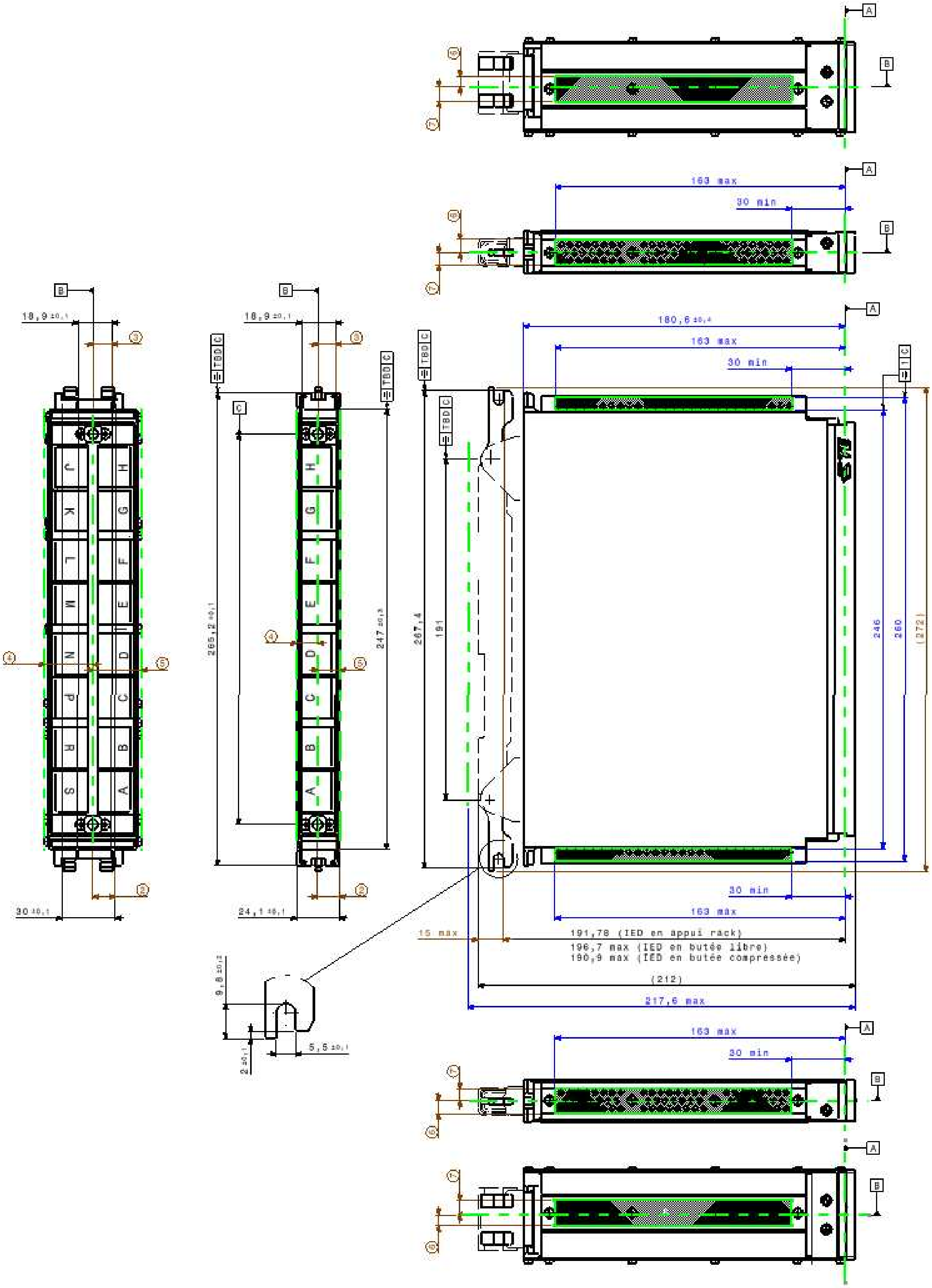


	Standards Blades	Width Blade (PSM)	Specifics blades (double row)
Width	24.1 mm (0.95”)	37.8 mm (1.49”)	55 mm (2.17”)
Height	272 mm (10.71”)	272 mm (10.71”)	272 mm (10.71”)
Depth	212 mm (8.35”)	212 mm (8.35”)	212 mm (8.35”)
Minimal gap	2.98 mm	2 mm	2.98 mm

Picture 8 : blade overview (for information)

12.7.2 Packaging description

12.7.2.1 Blade outline



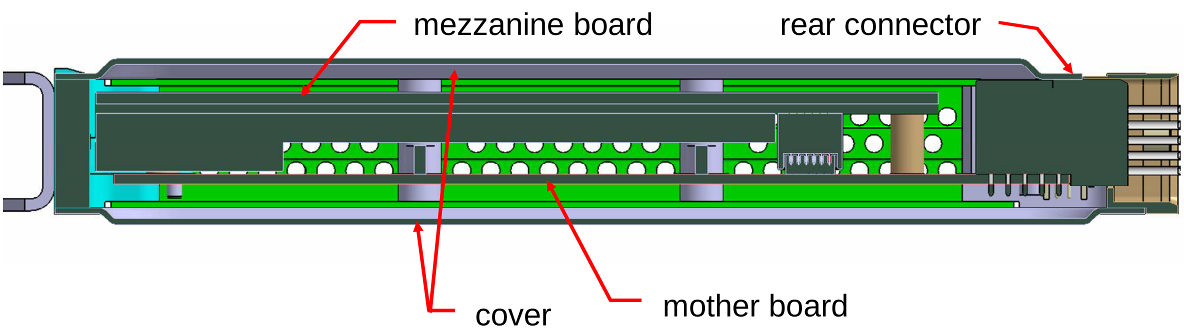
Picture 9 : Blade TYCO/RADIALL

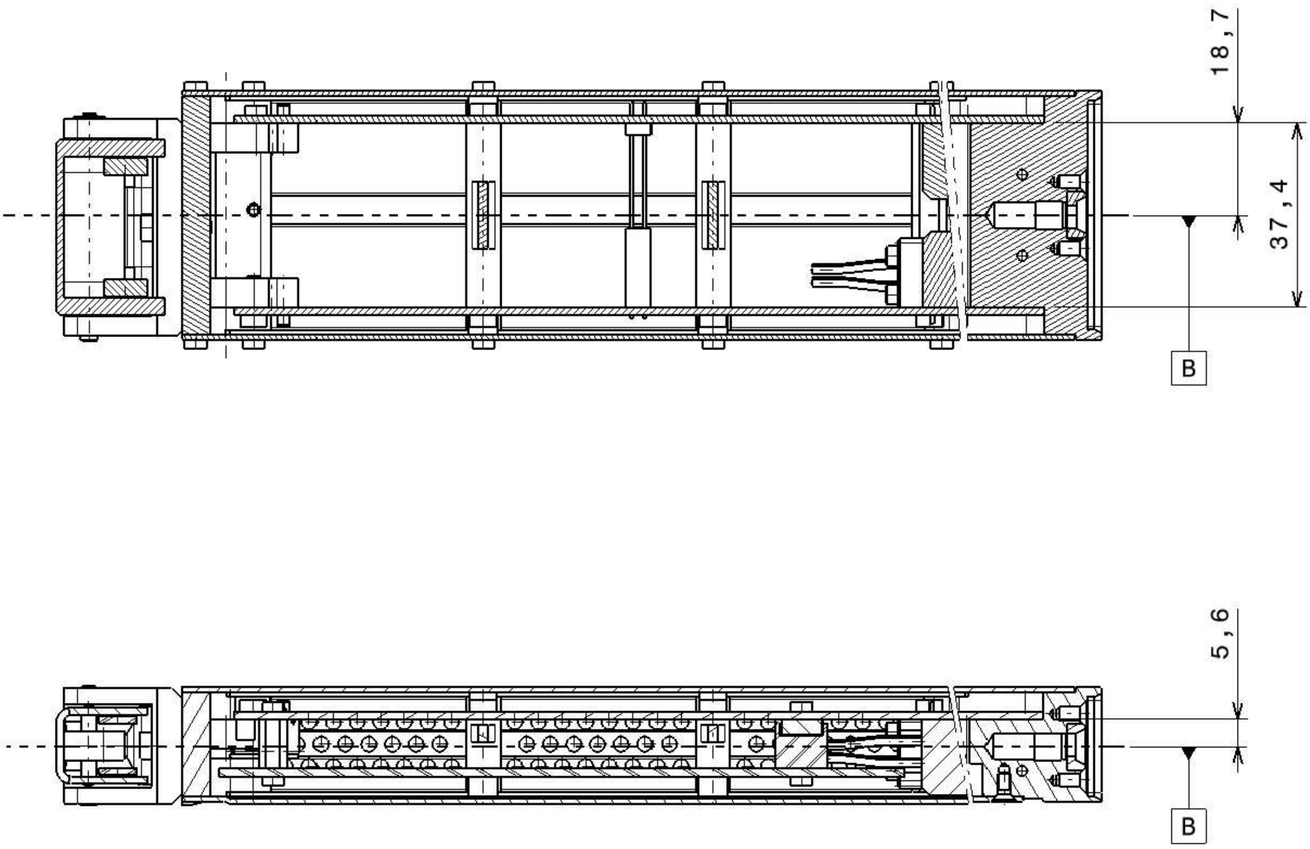
Complementary values of the previous drawing:

Value	Standard blade TYCO	Standard blade RADIALL	Double row blade TYCO	Double row blade RADIALL
2	12.31 ±0.2	14.75 ±0.2	12.55 ±0.2	22.35 ±0.2
3	10 ±TBD	12.15 ±TBD	10.5 ±TBD	13.3 ±TBD
4	12.04 max	9.6 max	27.35 max	27.25 max
5	12.56 max	15 max	27.35 max	32.25 max
6	7.4 max	4.3 max	6.1 max	3.3 max
7	6.8 max	9.8 max	8.2 max	11 max

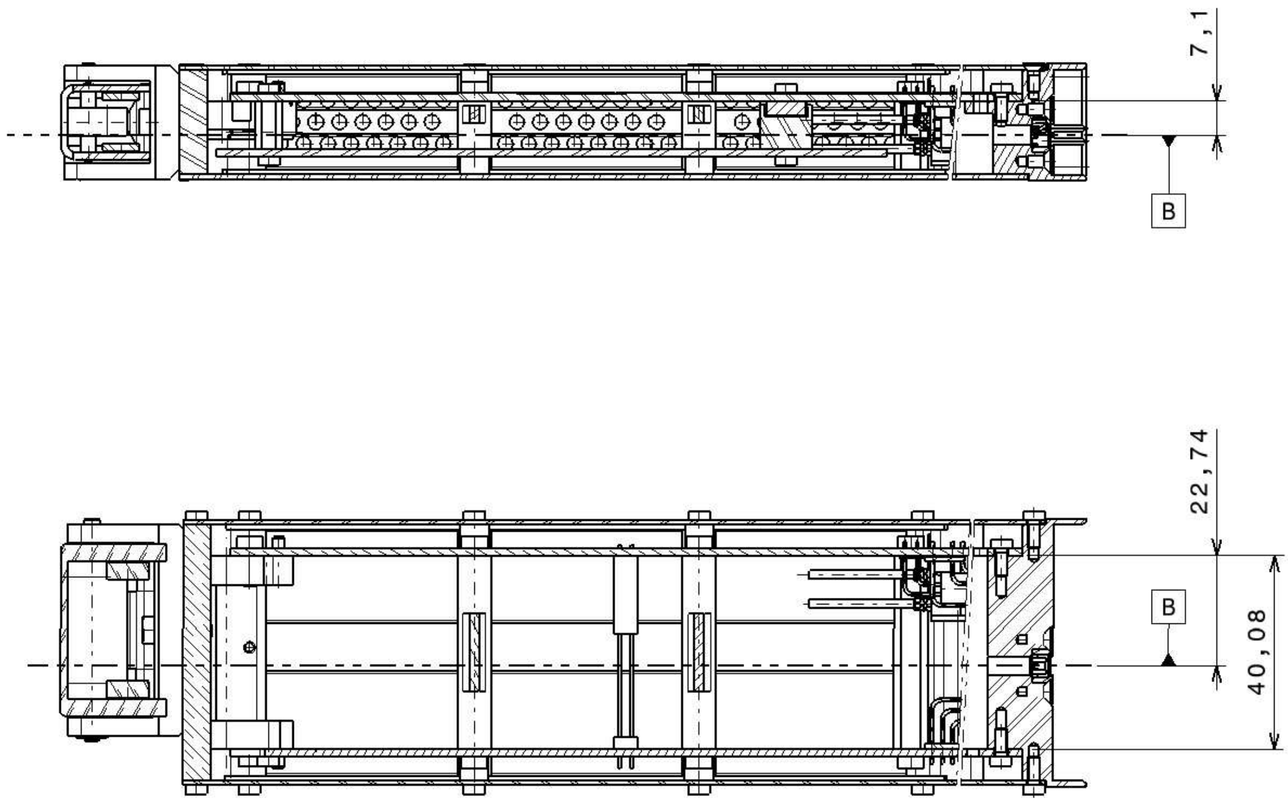
Picture 10 : Table of values for blade TYCO and RADIALL

12.7.2.2 Blade internal description



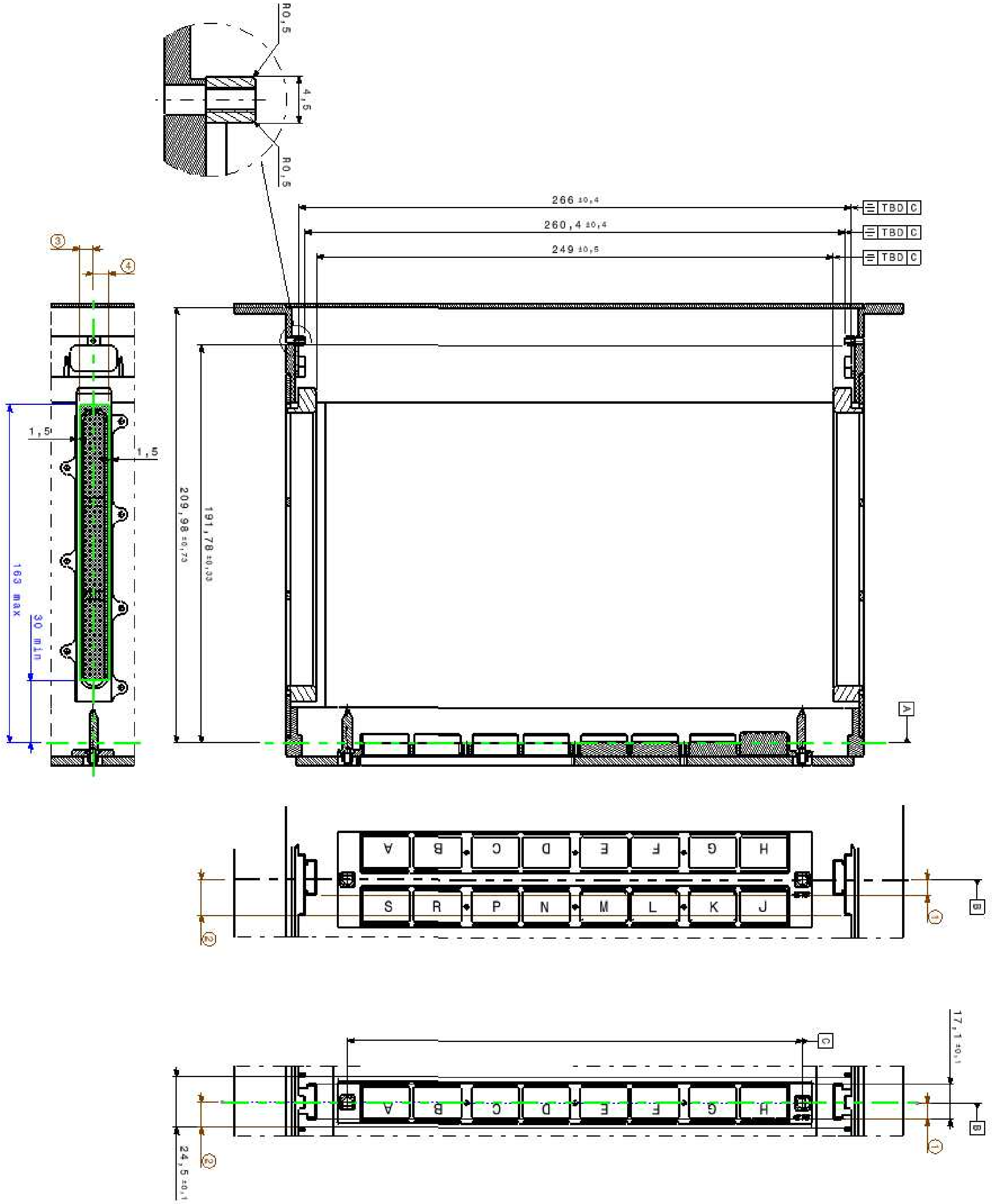


Picture 11 : section TYCO blade



Picture 12 : section RADIALL blade

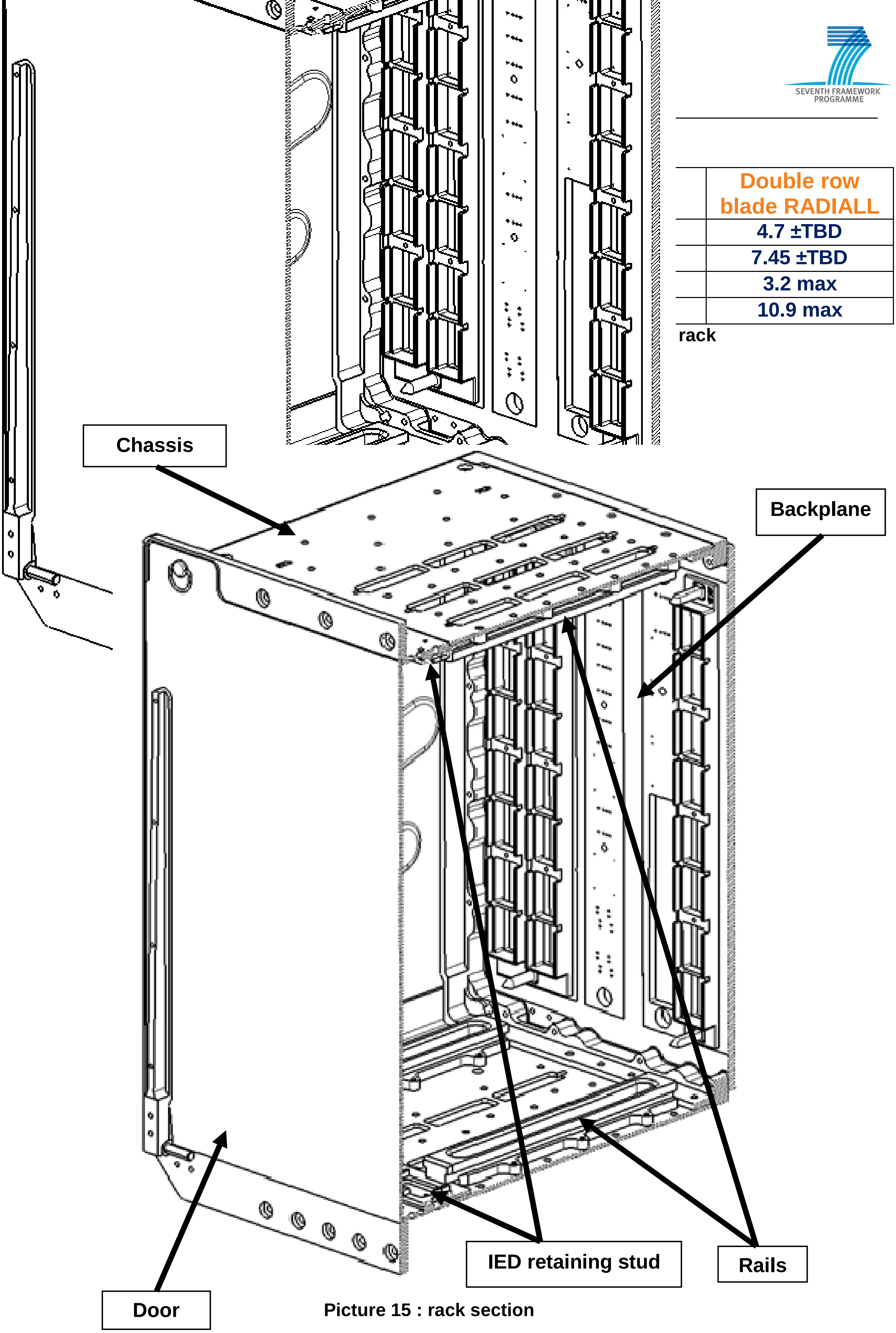
Chassis interface outline conditions



Picture 13 : TYCO/RADIALL section of the rack

	Double row blade RADIALL
	4.7 ±TBD
	7.45 ±TBD
	3.2 max
	10.9 max

rack

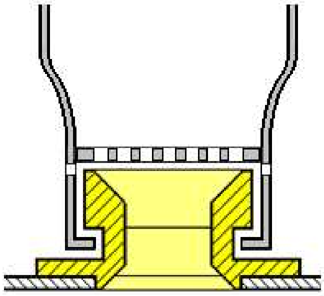


Picture 15 : rack section

12.8 REQUIREMENTS AND STANDARD ARCHITECTURE OF RACK (BASIS)

12.8.1 Common functional rack

12.8.2 Rack basis packaging description



Picture 16 : interface blade/rail

12.9 OPERATING CHARACTERISTICS.

12.9.1 Environnemental requirements are Applicables to Cabinet level

Section RTCA DO160-F	Requirement description	Category
4	Temperature and Altitude	A2,C2
5	Temperature Variation	C
6	Humidity	A
7	Operational Shocks and Crash Safety	B
8	Vibration	R (C)
9	Explosion Proofness	N/A
10	Waterproofness	W
11	Fluids Susceptibility	F
12	Sand and Dust	D
13	Fungus Resistance	F
14	Salp Spray	N/A
15	Magnetic Effect	Y or Z
16	Power Input	AC ➔ A(CF/NF/WF)_HLPI DC ➔ A/B/D/Z_RI
17	Voltage Spike	A
18	Audio Frequency Conducted Susceptibility – Power Inputs	AC➔R(CF/NF/WF) DC➔R/B/Z
19	Induced Signal Susceptibility	C_C/N/W
20	Radio Frequency Susceptibility (Radiated and Conducted)	Conducted ➔M/O Radiated➔G/L
21	Emission of Radio Frequency Energy	P
22	Lightning Induced Transient Susceptibility	A4G/J44 or B4H/K44 A5G/J55 or B5H/K55
23	Lightning Direct Effects	TBD
24	Icing	N/A
25	Electrostatic Discharge	A
26	Fire, Flammability	N/A

Picture 17 : Environmental requirements

12.9.1.1 Temperature and altitude

Environmental Tests	A2	C2
Operating low temperature	-15℃	-55℃
Operating High temperature	+70℃	+70℃
Short-time operating low temperature	-40℃	-55℃
Short-time operating high temperature	+70℃	+70℃
Loss of cooling test	+40℃	+40℃
Ground survival low temperature	-55℃	-55℃
Ground survival high temperature	+85℃	+85℃
Altitude	15 000ft / 4 600m	35 000ft / 10 700m
Decompression test	(1)	N/A
Overpressure test	170 kPa	N/A

Picture 18 : Temperature and altitude requirements

(1) The lowest pressure applicable for the decompression test is the maximum operating altitude for the aircraft in which the equipment will be installed.

12.9.1.2 Temperature Variation

Category C - For equipment in a temperature-controlled internal section of the aircraft: 2°C minimum per minute.

12.9.1.3 Humidity

Category A - Standard Humidity Environment

The standard humidity environment ordinarily provides an adequate test environment for equipment intended for installation in civil aircraft, non-civil transport aircraft and other classes, within environmentally controlled compartments of aircraft in which the severe humidity environment is not normally encountered.

12.9.1.4 Operational Shocks and Crash Safety

Category B - Equipment tested for standard operational shock and crash safety.

12.9.1.5 Vibration

Fixed-Wing - Sine of 3 Hrs/Axis less 30 min/dwell (max 4 dwells) or Random at perf. Level (minimum of 10 minutes) and 3 Hrs Endurance level (repeat in all 3 axes).

12.9.1.6 Waterproofness

Category W - Equipment that is installed in locations where it is subjected to falling water (generally the result of condensation) in the course of normal aircraft operations is identified as Category W. For equipment intended for installation in such locations, the drip proof test procedure applies and the equipment is identified as Category W.

12.9.1.7 Fluids Susceptibility

Category F - Equipment that has passed the tests covered in this section is identified as Category F. Details of the test fluids involved and the methods used shall be provided in the Environmental Qualification Form.

12.9.1.8 Sand and Dust

Category D - Equipment tested as recommended in the following paragraphs for Dust test is identified as Category D. Such equipment can be installed in locations where the equipment is subjected to blowing dust in the course of normal aircraft operations.

12.9.1.9 Fungus Resistance

Category F - Equipment that is installed in an environment where it will be exposed to severe fungus contamination is identified as Category F and shall be subjected to the fungus resistance test. If all materials used in the construction of the equipment can be shown to be non-nutrients for the growth of fungi, either through their composition or through previous testing, this test is not required. If non-nutrient material certification is utilized for this verification, this fact shall be declared on the Environmental Qualification Form.

12.9.2 Contacts conditions

- **ELECTRICAL CONDITIONS**Rated current : according to standards for contacts.
- Insulation resistance at ambient temperature: 5000MΩ.
- Withstanding voltage at sea level: 1500 V r.m.s.
- Withstanding voltage from 15000 m to 21000 m: 800 V r.m.s.

12.9.2.1 Environmental conditions.

- Minimum temperature: TBD℃
- Maximum temperature: TBD class C at +125℃
- Corrosion resistance and fluid resistance: TBD see EN yyyy-001 or ENxxxx-001

12.9.2.2 Mechanical conditions.

Mechanical endurance : ~~500~~ TBD mating and unmating cycles for contacts; ~~100~~ TBD mating and unmating cycles for locking mechanisms.

12.9.2.3 Housing electrical continuity.

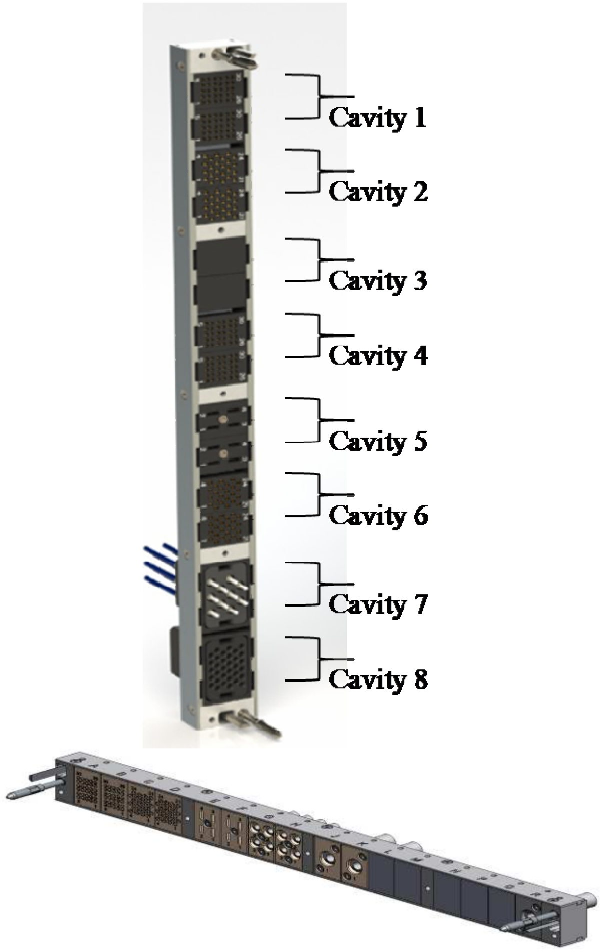
Maximum resistance between blade and empty cabinet is **TBD** (mΩ**)**

12.9.2.4 Shielding effectiveness.

Frequency (MHz)	**Minimum attenuation (dB)**
100	65
200	63
300	63
400	62
500	60
600	60

12.10 CONNECTORS CONSIDERATION

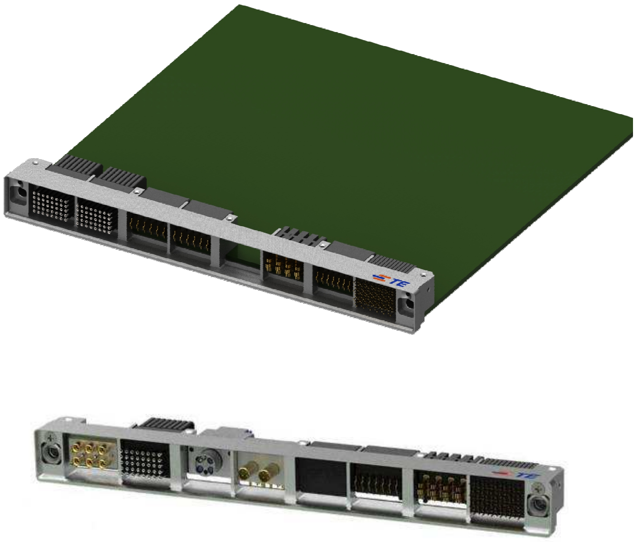
The interfaces connectors defines for blades and chassis are describes in the Technical report connectivity -D34 document.



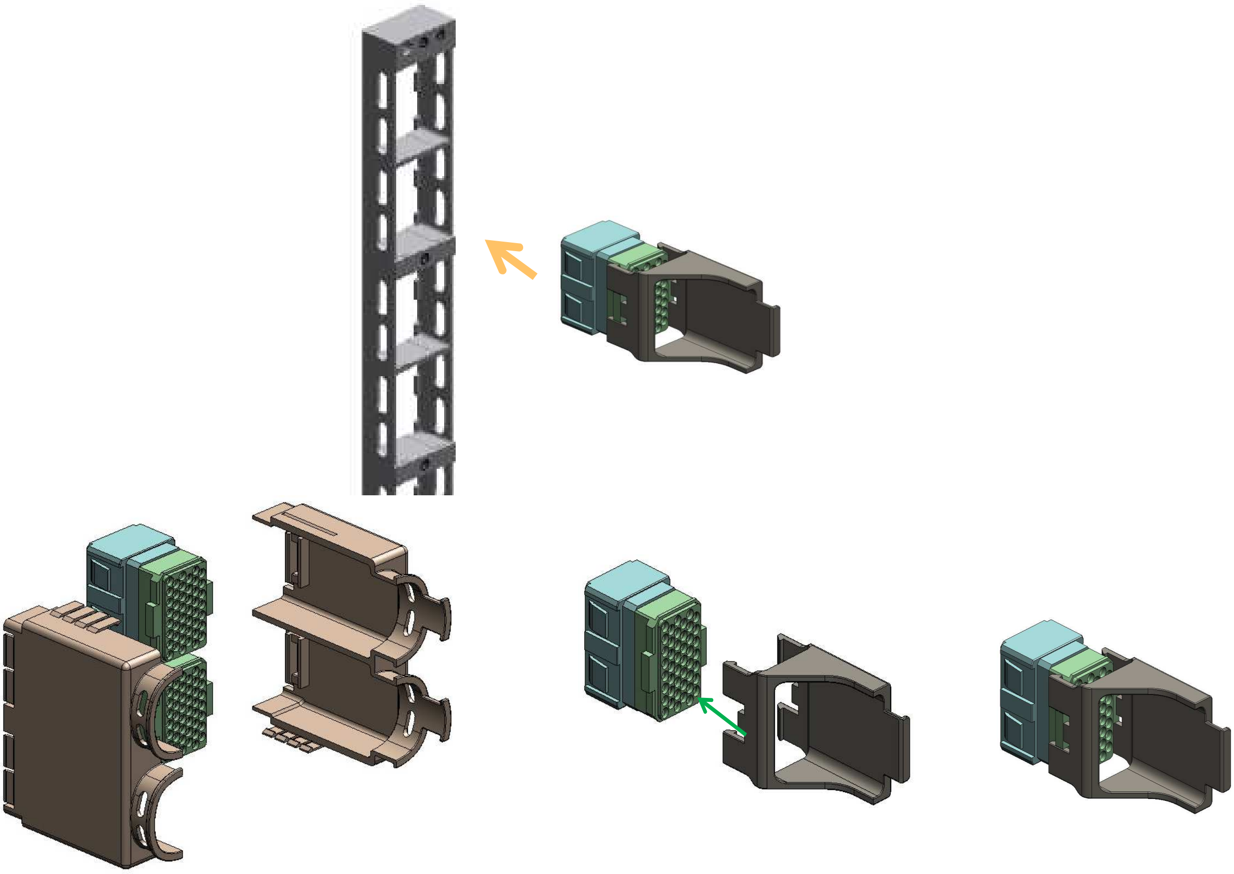
Picture 19 : RADIALL overview (full back - panel side)

Picture 20 : RADIALL overview (blade side)

Picture 21 : TYCO overview (full back - panel side)

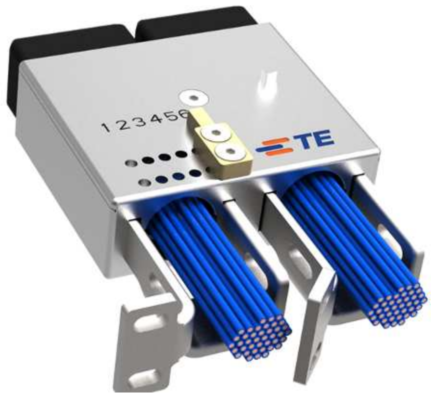


Picture 22 : TYCO overview (blade side)



shielding concept Ty-rap harness hold concept

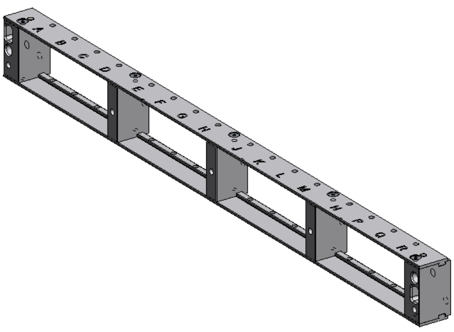
Picture 23 : RADIALL - Direct aircraft connection (cabinet side)

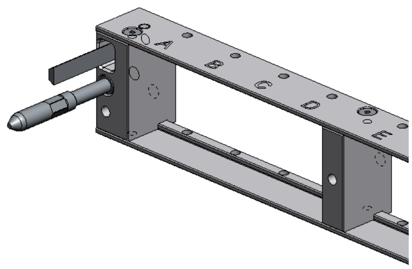


shielding concept Ty-rap harness hold concept

Picture 24 : TYCO - Direct aircraft connection (cabinet side)

12.10.1 Connector bezel

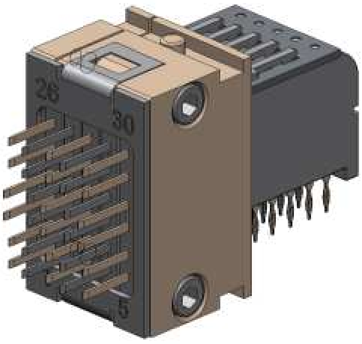




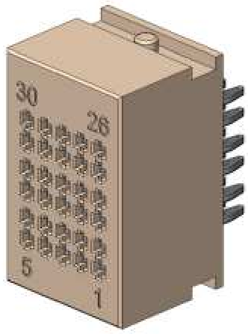
12.10.2 Modules contact arrangements.

Module and half module consideration
Dans chacun des 4 compartiments, on peut installer 2 modules ou 4 demi-modules suivant les besoin d'interface du blade avec le Backplane .
Chacun des compartiments peut aussi être composer de 2 demi modules de contacts

12.10.2.1 **High speed module** => at least **X** 100-Ohms differential pairs

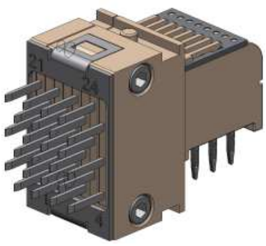


Blade side (press-fit)

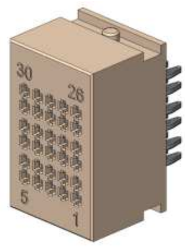


Back-panel side (press-fit)

12.10.2.2 **I/O module** => at least X contacts / 3 Amp.



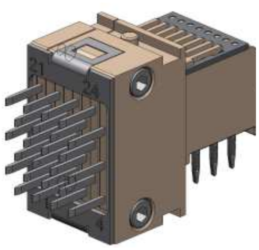
Blade side



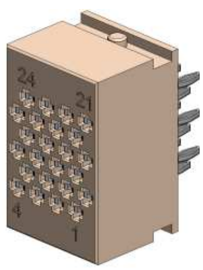
Back-panel side (press-fit)

12.10.2.3 **Power module** => at least 10 Amps / 36 Amps / 70 Amps

10 Amp

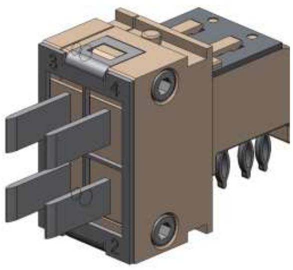


Blade side

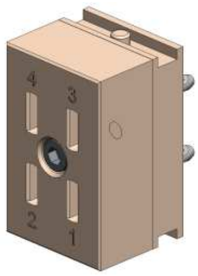


Back-panel side

36 Amps

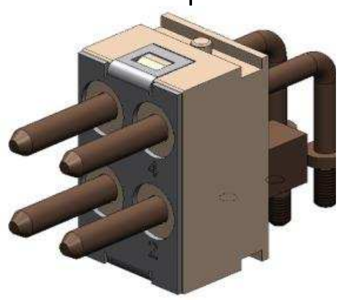


Blade side



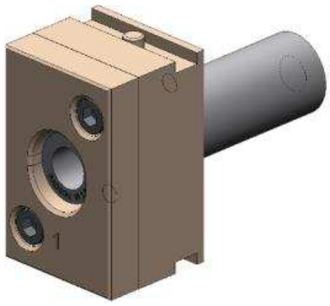
Back-panel side

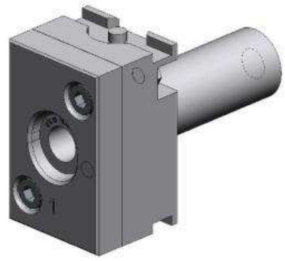
70 Amps



Blade side (press fit)

12.10.2.4 **Bonding module**





12.10.2.5 **Direct aircraft modules**

- **Signal contacts** => 45x #22 contacts (conform to ARINC 600 specification)
    - o with male crimping technology on cabinet side
    - o male contact is protected by the insert
    - o female press-fit and/or soldering technology on blade side

- **others signal contacts**
    - o modules definition accept all contacts type meet in ARINC600 specification /EN3155,

- **module for COAX. / TRIAX. / QUADRAX / OPTICAL**
    - o modules definition accept all contacts type meet in ARINC600 specification / EN 3155,

13 CONCLUSION

This project grouping together the major European aerospace players has been a unique opportunity to define common requirements and propose solutions in the complex and multidomain field of equipment packaging for the future aerospace equipment.

The results are impressive and several above the state of the art technologies have been successfully implemented (New cooling technologies, direct aircraft connectivity, modular versatile connectors, and composite lightweight structures).
In more details:

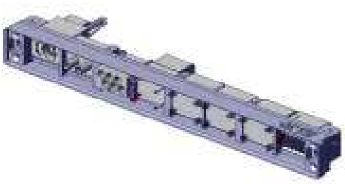
Three racks versions have been developed during the PRIMAE project. These racks families share the same blades and have been designed for different functions and environments.

CPC : Thav FR

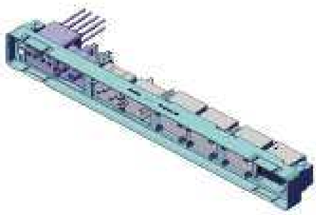
RHPC : BAE UK

RIOIC : Diehl GE

Two Modular connectors have been produced; these connectors propose direct aircraft connectivity and are compatibles for the PRIMAE racks.

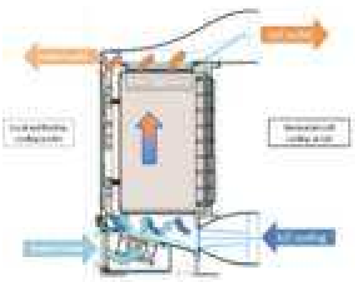


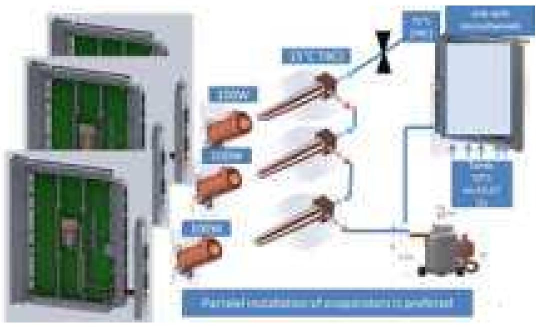
TYCO



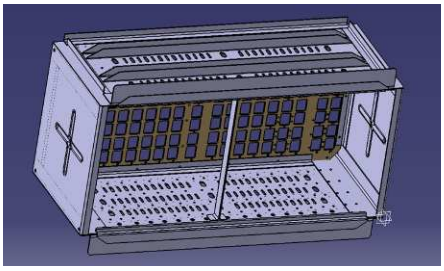
RADIALL

New advanced cooling techniques have been developed and tested positively, these technique are capable of hot spot up to 30 w and 100 w for total power disipation.



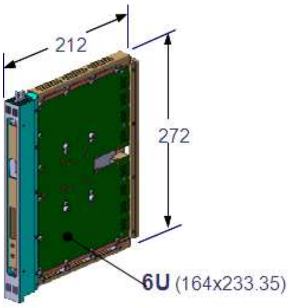


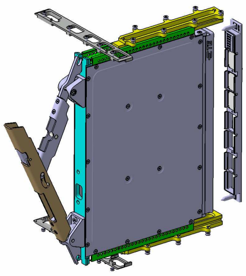
A composite version of CPC rack has been developed and has demonstrated the feasibility of a weight reduction of minimum 30%, new shielding technique have been inplented.

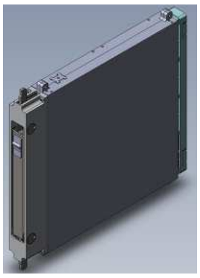


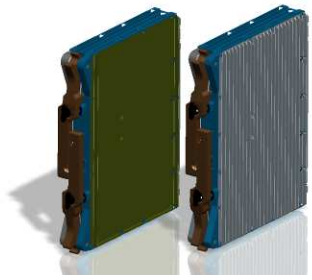
CFRD Composite
Developed in DTC (NL) and Aalto University (FI)

A market standard for factor has been proposed for the blades: called "6U", with standardized interfaces.

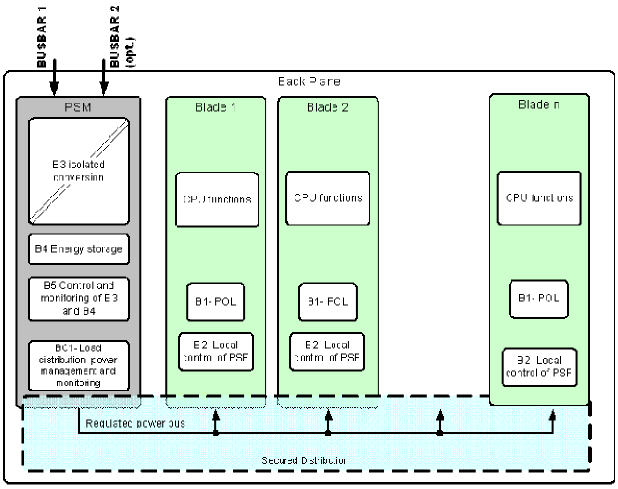




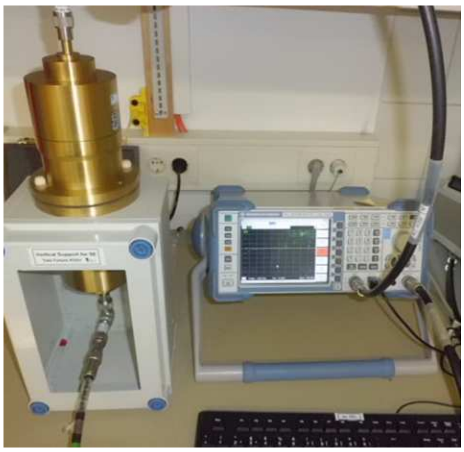




A centralized smart power-supply has been developed in the PRIMAE project and shielding recommendations have been produced, as well as new shielding effectiveness measurement methods.



Centralized PSM



Shielding effectiveness

The tests planned in this study have been performed with good results, some improvements will be necessary to improve the maturity assessment level (TRL wich is estimated between 4 and 5 depending on the topics), and the standardization process will be continued on the base of such improvement when agreed by the aerospace community inside and outside Europe to create a real worldwide standard

WHAT'S NEXT?

- After termination of the PRIMAE project, some specific additional tests will be performed by the rack manufacturers during the year 2015.
- Depending on the success in the adoption of the standard by the air-framers, the activation of the ASD – STAN group D2 S11 will be made.
- It is planned to continue the development of the future standard either through an aircraft programme or through further R&T studies like PRIMAEUS
- An international standard is necessary for future Modular Avionics equipment: PRIMAE is a serious candidate with a large European base, and a first validation step has reached a TRL 5 maturity at the packaging level.

FUTURE POSSIBLE COOPERATION

PRIMAEUS (Packaging Reusable for Integrated Modular Avionics and Electronics with the USA and rest of the world) has been discussed to pursue the standard improvement and reach a worldwide acceptance thought a multilateral cooperation including the USA.

<u>Main eu contribution</u>
Based on the PRIMAE project result, the EU partners will provide a candidate packaging standard covering all the packaging domains (thermal, mechanical, connectors, power supply, EMC...) with justifications

<u>Main US/Other contribution</u>

- US/Row will propose challenging options so that at project termination a common open standard will be agreed
- To validate the alternatives and make the right choices, simulations and comparative tests will be performed in each packaging domain.

<u>Interest of the Cooperation</u>
To involve early enough the US and international players, in order to enlarge the base of the future standard to a wider community of users outside Europe and worldwide, and to guaranty that the common developed standard will satisfy the futures programmes all over the world.

During the EEAG work shop held in Valence the non-European participants invited (BOEING, HONEYWELL, AVIAGE, ROCKWELL, EMBRAER GOS NIIAS and AIRLINES…) and former-PRIMAE European partners have confirmed their interest in launching the PRIMAEUS study.