SAFRAN ENGINEERING SERVICES
C++ PROGRAMMING UNDER DO178 - 332

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January 2017

SAFRAN

C++ programming under DO178 / DO332

Course organization

Planning			Teatcher	Content	Room
12/12/2017	10h15	12h15	Manon	Presentation of DO178 / DO 332 Practical work on landing gear monitoring system	Caud07
12/12/2017	13h15	15h15	Manon	Practical work on landing gear monitoring system specification	D202
19/12/2017	13h15	15h15	Dupouy	Recall on C++ basics Zoom on DO 332 (review of main FAQ in DO332)	D202
19/12/2017	15h30	17h30	Dupouy	Practical work on landing gear monitoring system class modelling / C++ coding / testing	D202
10/01/2018	10h15	12h15	Dupouy	Practical work on landing gear monitoring system class modelling / C++ coding / testing	D203
10/01/2018	13h15	15h15	Dupouy	Practical work on landing gear monitoring system class modelling / C++ coding / testing	D203
17/01/2018	10h15	12h15	Dupouy	Practical work on landing gear monitoring system class modelling / C++ coding / testing	D205
17/01/2018	13h15	15h15	Dupouy	Practical work on landing gear monitoring system class modelling / C++ coding / testing	D205
22/01/2018	10h15	12h15	Dupouy	Practical work on landing gear monitoring system class modelling / C++ coding / testing	D205
22/01/2018	13h15	15h15	Dupouy	Exam	D205

Objectives

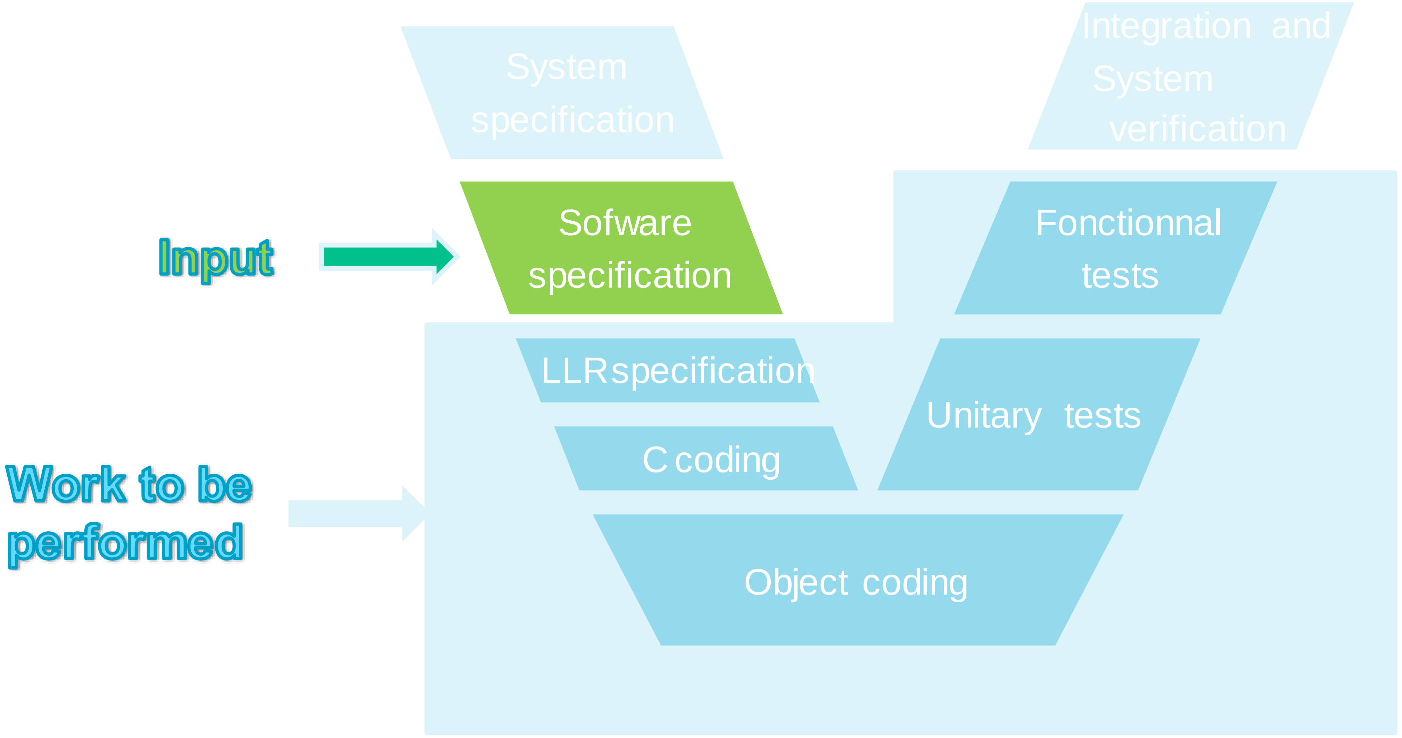
Main pedagogical objectives:

- To get acquainted with the basis of object coding for critical software
- To be able to realize simple coding using C++

Detailed pedagogical objectives:

- To get acquainted with critical software
- To get acquainted with DO178C norm and related refinements
- To get acquainted with DO178C process
- To get acquainted with DO332
- To get acquainted with the concept of Configuration management and Modification management
- To get acquainted with the use of manual coding versus automatic coding

Work to be performed



Work to be performed

Work to be performed:

- Write the LLR specification and the data dictionnary, trace with HLR, apply related check list
- Write the class diagram, trace with LLR, apply related check list
- Write the software using C++, trace with LLR, apply related check list
- Write test cases, trace with LLR, apply related check list

Furnished document:

Software Requirements Specification (presented next)
Template of traceability matrix
Template of check list
Template of data dictionnary

Practical work template

Software Requirements Specification Extracts

SYSTEM OVERVIEW

The Landing Gear Monitoring System (LGMS) is composed of several functions.
One of these functions is the Brake Temperature Monitoring System (BTMS).
It is presented next:

Indication:

Displays brake temperatures to the flight and maintenance crew for information and fault diagnosis.

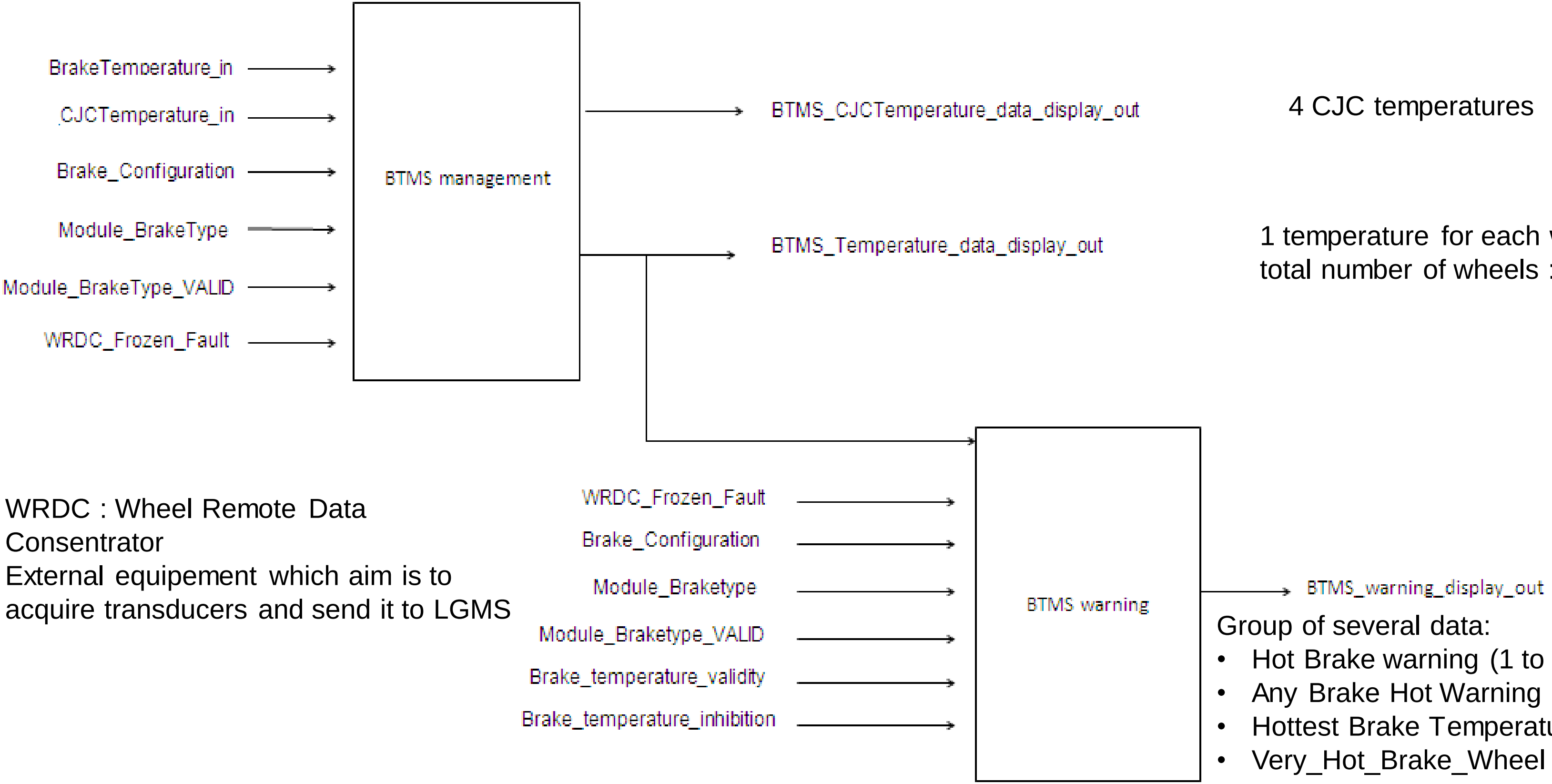
Warning:

•Warns the flight crew that the brakes are at a temperature which could prevent a safe RTO being performed.

•Warns the flight crew that the brakes are at a temperature which could ignite a flammable source (e.g hydraulic fluid).

•Warns the flight crew that the brakes are at a temperature which could raise the bay temperature such that the bay structure and equipment in the wheel wells could be damaged.

Software Requirements Specification Extracts



4 CJC temperatures

1 temperature for each wheel, total number of wheels : 12

WRDC : Wheel Remote Data Consentrator
External equipement which aim is to acquire transducers and send it to LGMS

Group of several data:

- Hot Brake warning (1 to 12)
- Any Brake Hot Warning
- Hottest Brake Temperature (1 to 12)
- Very_Hot_Brake_Wheel (1 to 12)

Software Requirements Specification Extracts
BTMS transformations and indications

BTMS Management req

A350_LGMS_HLR_0037

[

The measured brake temperature range shall be [-55°C, +1100°C].

Outside this range, the output measured brake temperature shall be frozen to its last valid value and after a confirmation time of 9.6 seconds, the validity of the output measured Brake Temperature shall be set to FALSE if initially was TRUE.

If the measured brake temperature comes back in the range [-55°C;1100°C] after a confirmation time of 9.6 seconds, the output measured brake temperature shall be set to the measured brake temperature and its output validity shall be set to the input validity.

]

A350_LGMS_HLR_0038

[

The CJC temperature received by the WRDC shall be [-55°C ; 150°C].

Outside this range, output cold junction Temperature value shall be frozen at its last valid value and after a confirmation time of 9.6 seconds, the output validity of cold junction Temperature shall be set to FALSE if initially was TRUE.

If the CJC temperature comes back in the range [-55°C;150°C] after a confirmation time of 9.6 seconds, the output validity of cold junction temperature shall be set to input cold junction validity and output cold junction Temperature value shall be set to input cold junction temperature.

]

Software Requirements Specification Extracts
BTMS Warnings

BTMS Warning req

A350_LGMS_HLR_0041

[

The partition shall compute the Hot Brake warning (contained in the BTMS_warning_display_out) for each braked wheel i (i= 01, 02,... 12) as following:

- If the brake temperature rises above the brake temperature threshold (300 °C), the Brake_Hot_Wheel_i shall be set to "Active",
- If the brake temperature falls 10°C below the threshold, the "Hot Brake warning" shall be set to "Inactive".

The activation and deactivation of each bit are confirmed during 9.6 seconds.

- If the brake temperature is between the 2 thresholds [Hot Temperature threshold; Hot Temperature threshold - 10], the LGMS OPER partition shall reset the confirmation time and keep the state of the hot brake warning.

]

A350_LGMS_HLR_0044

[

A global **Any Brake Hot Warning** shall be set to "Active" when one **Hot Brake Warning** is set to "Active". It shall be set to "Inactive" when all **Hot Brake Warning** are set to "Inactive".

]

Software Requirements Specification Extracts
BTMS Warnings

BTMS Warning req

A350_LGMS_HLR_0045

[

For each wheel the Hottest Brake Temperature bit shall be set to "Active", Hottest_Brake_Wheel_i="Active", i= 01, 02,... 12, when all of the following conditions occur:

- the measured brake temperature BrakeTemperature_Wheel_i is greater or equal to 100°C for the current wheel
- the consolidated validity of the BrakeTemperature_Wheel_i is TRUE
- the measured brake temperature BrakeTemperature_Wheel_i is greater than all the valid measured brake temperature for the other wheels

For each wheel if the Hottest Brake Temperature bit have been set to "Active" - Hottest_Brake_Wheel_i = « Active » then the Hottest Brake Temperature bit shall be set to "Inactive", when one of the following conditions occur:

- the measured brake temperature BrakeTemperature_Wheel_i is smaller than 100°C for the current wheel and the valisity of BrakeTemperature_Wheel_i is TRUE
- the consolidated functional validity of FS_BrakeTemperature_Wheel_i is FALSE
- the measured brake temperature is smaller than any other valid wheel

]

A350_LGMS_HLR_0122

[

When several wheels have the same measured brake temperature at cycle N, greater or equal to 100°C, and the Hottest Brake Temperature bit was already set to 'Active' for one of them at cycle N-1, then the Hottest Brake Temperature bit shall be kept for the wheel already set to 'Active'.

When several wheels have the same measured brake temperature at cycle N, greater or equal to 100°C, and no Hottest Brake Temperature bit was set to 'Active' for one of them at cycle N-1, then the Hottest Brake Temperature bit shall be set to 'Active' for the wheel with the smallest index.

]

Software Requirements Specification Extracts
BTMS Warnings

BTMS Warning req

A350_LGMS_HLR_0149

[

The partition shall set the Very Hot Brake parameters to « Active » for each braked wheel,
Very_Hot_Brake_Wheel_i="Active", i= 01, 02,... 12, if the temperature of brake for this wheel rises above 800°C.
It shall set the « Very hot Brake parameters » to "Inactive" when the temperature for this wheel falls below 790°C.
The activation and deactivation of each parameters are confirmed during 9.6s.
If the temperature of brake for this wheel is between [790°C;800°C], the LGMS OPER partition reset the confirmation time and keep the state of the very hot brake parameters as it is.

Note : To alert the maintenance crew of the very hot brake temperature - and therefore potential damage to the axle.

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