

OEM Example #1

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Applicability

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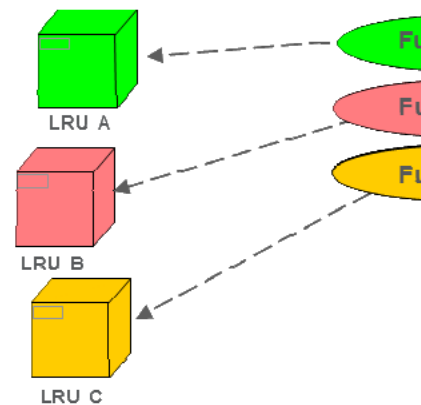
Glossary and acronyms

A/C	Aircraft
AFDX	Avionics Full Duplex
A429	ARINC 429
CM	Computing Modules
FC	Failure Cause
DSI/O	Discrete Input / Output
FE	Failure Effect
FEC	Failure Effect Category
FF	Function Failure
FM	Failure Mode
H/W	Hard ware
I/O	Input / Output
IMA	Integrated Modular Avionics
IMA	Integrated Modular Avionics
LRU	Line Replaceable Unit
MSI	Maintenance Significant Item
ST	Selected Task

1. General

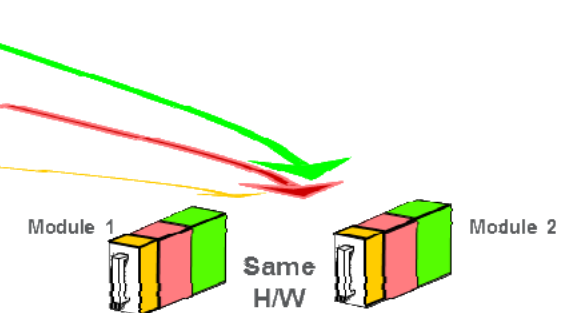
1.1. IMA concept

Conventional Avionics



One equipment per function

Computing Modules (CM)



Standard computing modules running several applications

Applicability

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2. Description

2.1. CM functions

2.1.1. General CM overview

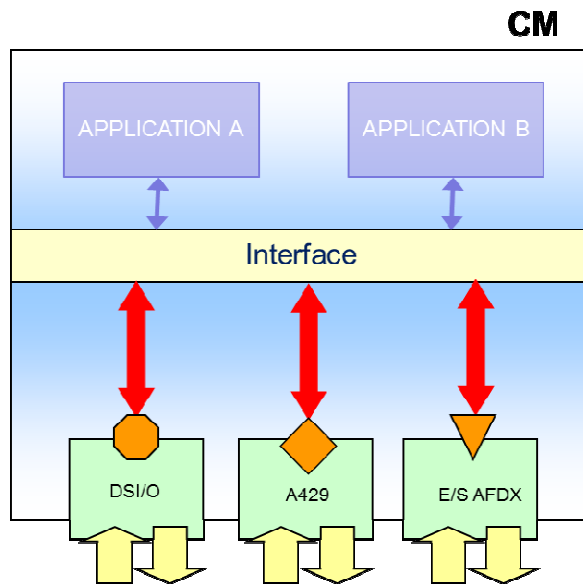


Figure: CM functional architecture

2.1.2. CM hardware architecture

2.1.3. CM software architecture

2.1.4. Partitioning and segregation

2.2. Specific CM-1 and CM-2 data

2.2.1. CM-1 and CM-2 location

2.2.2. CM-1 and CM-2 power supply

3. Interface with the cockpit crew

4. Interface with the other A/C systems

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MSG-3 Analysis – Systems / Powerplant		Item Description	
<h2>5. Consequences-of-failure matrix</h2>			
<p>This CM analysis focus on the analysis of all the CM functions that are not specific to one of the hosted system applications - this analysis excludes functions specific to system applications hosted within the CM.</p>			
<p>The CM-1 and CM-2 host the application software for:</p> <ul style="list-style-type: none">- Application A,- Application B,			
<p>These applications are completely described in:</p> <ul style="list-style-type: none">- The MSI 10-00-00 for Application A,- The MSI 20-00-00 and MSI 30-00-00 for Application B.		<p>On a single MSI, we provide the analysis of redundant Computing Modules, meaning hosting the same applications software.</p>	
<p>The aim of this section is to analyze the impacts of the CM failures on the hosted application by reviewing all the MSG-3 analyses where the CM-1 or CM-2 appears as failure cause. The result of this review is presented on the 'CM-1 & CM-2 consequences-of-failure' matrix.</p>			
<p>This matrix is based on following MSG-3 analyses:</p> <ul style="list-style-type: none">- The MSI 10-00-00 'Application A' issue 3,- The MSI 20-00-00 'Application B, part 1' issue 4,- The MSI 30-00-00 'Application B, part 2' issue 4.-			
<p>To support FEC selection within Level 1 analysis, specific tables provide "FEC distribution at CM level" further to considered CM loss cases (total / partial CM loss).</p> <p>For each related case, an associated 'CM-1 & CM-2 consequences-of-failure' matrix is presented to support the assessment of the whole failure effects at A/C level. This FE results from source MSIs FE, by compilation.</p>			
<p>The analysis covers the following functional failures (which are the consequence of single failure of an electrical component of the CM) and their impacts on the hosted applications:</p> <ul style="list-style-type: none">- First, the total loss of CM-1 or CM-2,- Then, the loss of block of Input / Output data of CM-1 or CM-2:<ul style="list-style-type: none">o The loss of all the AFDX data (input and output),o The loss of all Discrete (input and output),o The loss of all the A429 busses.			
Applicability			
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5.1. Total loss of CM-1 or CM-2

									FEC @ CM level				
									5	6	7	8	9
APPLICATION A													
APPL A Failure Mode (FM)	APPL A FM#1	APPL A FM#2	APPL A FM#3	APPL A FM#4	APPL A FM#5	APPL A FM#6	APPL A FM#7						
FEC	5							0					
	6	X	X		X				3				
	7			X		X	X			4			
	8										0		
	9											0	
Selected tasks(ST)?		No	No	No	No	No	No	No					
APPLICATION B													
APPL B Failure Mode (FM)	APPL B FM#1	APPL B FM#2	APPL B FM#3	APPL B FM#4	APPL B FM#5	APPL B FM#6	APPL B FM#7	APPL B FM#8					
FEC	5								0				
	6				X					1			
	7										0		
	8			X							1		
	9	X	X			X	X	X				6	
Selected tasks(ST)?		No	No	No	Yes	No	No	No					
FEC distribution at CM level -->									0	4	4	1	6

Table - 'FEC distribution at CM level': Total loss of CM-1 or CM-2

This table is used to answer Level 1 question and FEC determination.

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Failure Modes (FM) after a total loss of CM-1 or CM-2:

MSI Source	Failure Mode (FM)	Functional Failure (FF)	Failure Effect (FE)	FC	FEC	Selected Task (ST)
MSI 10-00-00 APPLICATION A	APPL A FM#1	<i>Text of FF 1</i>	<i>Text of FE 1</i>	CM-1: AFDX, APPL A or CM-2: AFDX, APPL A	6	-
	APPL A FM#2	<i>Text of FF 2</i>	<i>Text of FE 2</i>	CM-1: AFDX, APPL A or CM-2: AFDX, APPL A	6	-
	APPL A FM#3	<i>Text of FF 3</i>	<i>Text of FE 3</i>	CM-1: AFDX, APPL A or CM-2: AFDX, APPL A	7	-
	APPL A FM#4	<i>Text of FF 4</i>	<i>Text of FE 4</i>	CM-1: AFDX, APPL A or CM-2: AFDX, APPL A	6	-
	APPL A FM#5	<i>Text of FF 5</i>	<i>Text of FE 5</i>	CM-1: DSO, APPL A or CM-2: DSO, APPL A	7	-
	APPL A FM#6	<i>Text of FF 6</i>	<i>Text of FE 6</i>	CM-1: DSO, APPL A or CM-2: DSO, APPL A	7	-
	APPL A FM#7	<i>Text of FF 7</i>	<i>Text of FE 7</i>	CM-1: DSO, APPL A or CM-2: DSO, APPL A	7	-
MSI 20-00-00 APPLICATION B, PART 1	APPL B FM#1	<i>Text of FF 1</i>	<i>Text of FE 1</i>	CM-1: DSO, APPL B or CM-2: DSO, APPL B	9	-
	APPL B FM#2	<i>Text of FF 2</i>	<i>Text of FE 2</i>	CM-1: DSI, APPL B or CM-2: DSI, APPL B	9	-
	APPL B FM#3	<i>Text of FF 3</i>	<i>Text of FE 3</i>	CM-1: DSI, APPL B or CM-2: DSI, APPL B	8	YES
	APPL B FM#4	<i>Text of FF 4</i>	<i>Text of FE 4</i>	CM-1: DSI, APPL B or CM-2: DSI, APPL B	6	-
MSI 30-00-00 APPLICATION B, PART 2	APPL B FM#5	<i>Text of FF 1</i>	<i>Text of FE 1</i>	CM-1: A429, APPL B or CM-2: A429, APPL B	9	-
	APPL B FM#6	<i>Text of FF 2</i>	<i>Text of FE 2</i>	CM-1: A429, APPL B or CM-2: A429, APPL B	9	-
	APPL B FM#7	<i>Text of FF 3</i>	<i>Text of FE 3</i>	CM-1: A429, APPL B or CM-2: A429, APPL B	9	-
	APPL B FM#8	<i>Text of FF 4</i>	<i>Text of FE 4</i>	CM-1: A429, APPL B or CM-2: A429, APPL B	9	-
FE after CM-1 or CM-2 failure:				Compilation of the effects, to establish DSB FE		

Table - 'CM-1 & CM-2 Consequences-of-failure' matrix: total loss of CM-1 or CM-2

The whole impact at A/C level of the total loss of CM-1 or CM-2 is the compilation of all the above listed Failure Effects.

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5.2. Loss of all AFDX data (input and output)

									FEC @ CM level				
									5	6	7	8	9
APPLICATION A													
APPL A Failure Mode (FM)		APPL A FM#1	APPL A FM#2	APPL A FM#3	APPL A FM#4	APPL A FM#5	APPL A FM#6	APPL A FM#7					
FEC	5								0				
	6	X	X		X					3			
	7			X		X	X	X			1		
	8											0	
	9												0
Selected tasks(ST)?		No	No	No	No	No	No	No					
APPLICATION B													
APPL B Failure Mode (FM)		APPL B FM#1	APPL B FM#2	APPL B FM#3	APPL B FM#4	APPL B FM#5	APPL B FM#6	APPL B FM#7	APPL B FM#8				
FEC	5									0			
	6				X						0		
	7											0	
	8			X								0	
	9	X	X			X	X	X	X				0
Selected tasks(ST)?		No	No	No	Yes	No	No	No	No				

Legend:

Not applicable to the analysed FF.

Table - 'FEC distribution at CM level': Loss of AFDX input and output data of CM-1 or CM-2

This table is used to answer Level 1 question and FEC determination.

Applicability

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Failure Modes after a loss of the AFDX input and output data for CM-1 or CM-2:

MSI Source	Failure Mode (FM)	Functional Failure (FF)	Failure Effect (FE)	FC	FEC	Selected Task (ST)
MSI 10-00-00 APPLICATION A	APPL A FM#1	<i>Text of FF 1</i>	<i>Text of FE 1</i>	CM-1: AFDX, APPL A or CM-2: AFDX, APPL A	6	-
	APPL A FM#2	<i>Text of FF 2</i>	<i>Text of FE 2</i>	CM-1: AFDX, APPL A or CM-2: AFDX, APPL A	6	-
	APPL A FM#3	<i>Text of FF 3</i>	<i>Text of FE 3</i>	CM-1: AFDX, APPL A or CM-2: AFDX, APPL A	7	-
	APPL A FM#4	<i>Text of FF 4</i>	<i>Text of FE 4</i>	CM-1: AFDX, APPL A or CM-2: AFDX, APPL A	6	-
FE after CM-1 or CM-2 failure:				Compilation of the effects, to establish DSB FE		

Table - 'CM-1 or CM-2 Consequences-of-failure' matrix: Loss of AFDX input and output data of CM-1 or CM-2

The whole impact at A/C level of the loss of AFDX input and output for CM-1 or CM-2 is the compilation of all the above listed Failure Effects.

Applicability

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5.3. Loss of all Discrete input / output

									FEC @ CM level									
									5	6	7	8	9					
APPLICATION A																		
APPL A Failure Mode (FM)		APPL A FM#1	APPL A FM#2	APPL A FM#3	APPL A FM#4	APPL A FM#5	APPL A FM#6	APPL A FM#7										
FEC	5								0									
	6	X	X		X					0								
	7			X		X	X	X			3							
	8											0						
	9												0					
Selected tasks(ST)?		No	No	No	No	No	No	No										
APPLICATION B																		
APPL B Failure Mode (FM)		APPL B FM#1	APPL B FM#2	APPL B FM#3	APPL B FM#4	APPL B FM#5	APPL B FM#6	APPL B FM#7	APPL B FM#8									
FEC	5									0								
	6				X						1							
	7											0						
	8			X								1						
	9	X	X			X	X	X	X				2					
Selected tasks(ST)?		No	No	No	Yes	No	No	No	No									
									FEC distribution at CM level -->									
									0	1	3	1	2					

Legend:


 Not applicable to the analysed FF.

Table - 'FEC distribution at CM level': Loss of Discrete input and output data of CM-1 or CM-2

This table is used to answer Level 1 question and FEC determination.

Applicability

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MSI Description : COMPUTING MODULES 1 & 2

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Failure Modes after a loss of the Discrete input and output data for CM-1 or CM-2:

MSI Source	Failure Mode (FM)	Functional Failure (FF)	Failure Effect (FE)	FC	FEC	Selected Task (ST)
MSI 10-00-00 APPLICATION A	APPL A FM#5	<i>Text of FF 5</i>	<i>Text of FE 5</i>	CM-1: DSO, APPL A or CM-2: DSO, APPL A	7	-
	APPL A FM#6	<i>Text of FF 6</i>	<i>Text of FE 6</i>	CM-1: DSO, APPL A or CM-2: DSO, APPL A	7	-
	APPL A FM#7	<i>Text of FF 7</i>	<i>Text of FE 7</i>	CM-1: DSO, APPL A or CM-2: DSO, APPL A	7	-
MSI 20-00-00 APPLICATION B, PART 1	APPL B FM#1	<i>Text of FF 1</i>	<i>Text of FE 1</i>	CM-1: DSO, APPL B or CM-2: DSO, APPL B	9	-
	APPL B FM#2	<i>Text of FF 2</i>	<i>Text of FE 2</i>	CM-1: DSI, APPL B or CM-2: DSI, APPL B	9	-
	APPL B FM#3	<i>Text of FF 3</i>	<i>Text of FE 3</i>	CM-1: DSI, APPL B or CM-2: DSI, APPL B	8	YES
	APPL B FM#4	<i>Text of FF 4</i>	<i>Text of FE 4</i>	CM-1: DSI, APPL B or CM-2: DSI, APPL B	6	-
FE after CM-1 or CM-2 failure:				Compilation of the effects, to establish DSB FE		

Table - 'CM-1 or CM-2 Consequences-of-failure' matrix: Loss of Discrete input and output data of CM-1 or CM-2

The whole impact at A/C level of the loss of Discrete input and output of CM-1 or CM-2 is the compilation of all the above listed Failure Effects.

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5.4. Loss of all A429 busses

									FEC @ CM level				
									5	6	7	8	9
APPLICATION A													
APPL A Failure Mode (FM)	APPL A FM#1	APPL A FM#2	APPL A FM#3	APPL A FM#4	APPL A FM#5	APPL A FM#6	APPL A FM#7						
FEC	5							0					
	6	X	X		X				0				
	7			X		X	X			0			
	8										0		
	9											0	
Selected tasks(ST)?	No	No	No	No	No	No	No	No					
APPLICATION B													
APPL B Failure Mode (FM)	APPL B FM#1	APPL B FM#2	APPL B FM#3	APPL B FM#4	APPL B FM#5	APPL B FM#6	APPL B FM#7	APPL B FM#8					
FEC	5								0				
	6				X					0			
	7										0		
	8			X								0	
	9	X	X			X	X	X	X				4
Selected tasks(ST)?	No	No	No	Yes	No	No	No	No					
FEC distribution at CM level -->									0	0	0	0	4

Table: FEC distribution at CM level': Loss of A429 busses of CM-1 or CM-2

This table is used to answer Level 1 question and FEC determination.

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Failure Modes after a loss of all A429 busses of CM-1 or CM-2:

MSI Source	Failure Mode (FM)	Functional Failure (FF)	Failure Effect (FE)	FC	FEC	Selected Task (ST)
MSI 30-00-00 APPLICATION B, PART 2	APPL B FM#5	<i>Text of FF 1</i>	<i>Text of FE 1</i>	CM-1: A429, APPL B or CM-2: A429, APPL B	9	-
	APPL B FM#6	<i>Text of FF 2</i>	<i>Text of FE 2</i>	CM-1: A429, APPL B or CM-2: A429, APPL B	9	-
	APPL B FM#7	<i>Text of FF 3</i>	<i>Text of FE 3</i>	CM-1: A429, APPL B or CM-2: A429, APPL B	9	-
	APPL B FM#8	<i>Text of FF 4</i>	<i>Text of FE 4</i>	CM-1: A429, APPL B or CM-2: A429, APPL B	9	-
FE after CM-1 or CM-2 failure:				Compilation of the effects, to establish DSB FE		

Table - 'CM-1 or CM-2 Consequences-of-failure' matrix: Loss of A429 busses of CM-1 or CM-2

The whole impact at A/C level of the loss of A429 busses of CM-1 or CM-2 is the compilation of all the above listed Failure Effects.

Applicability

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MSI
Description : COMPUTING MODULES 1 & 2

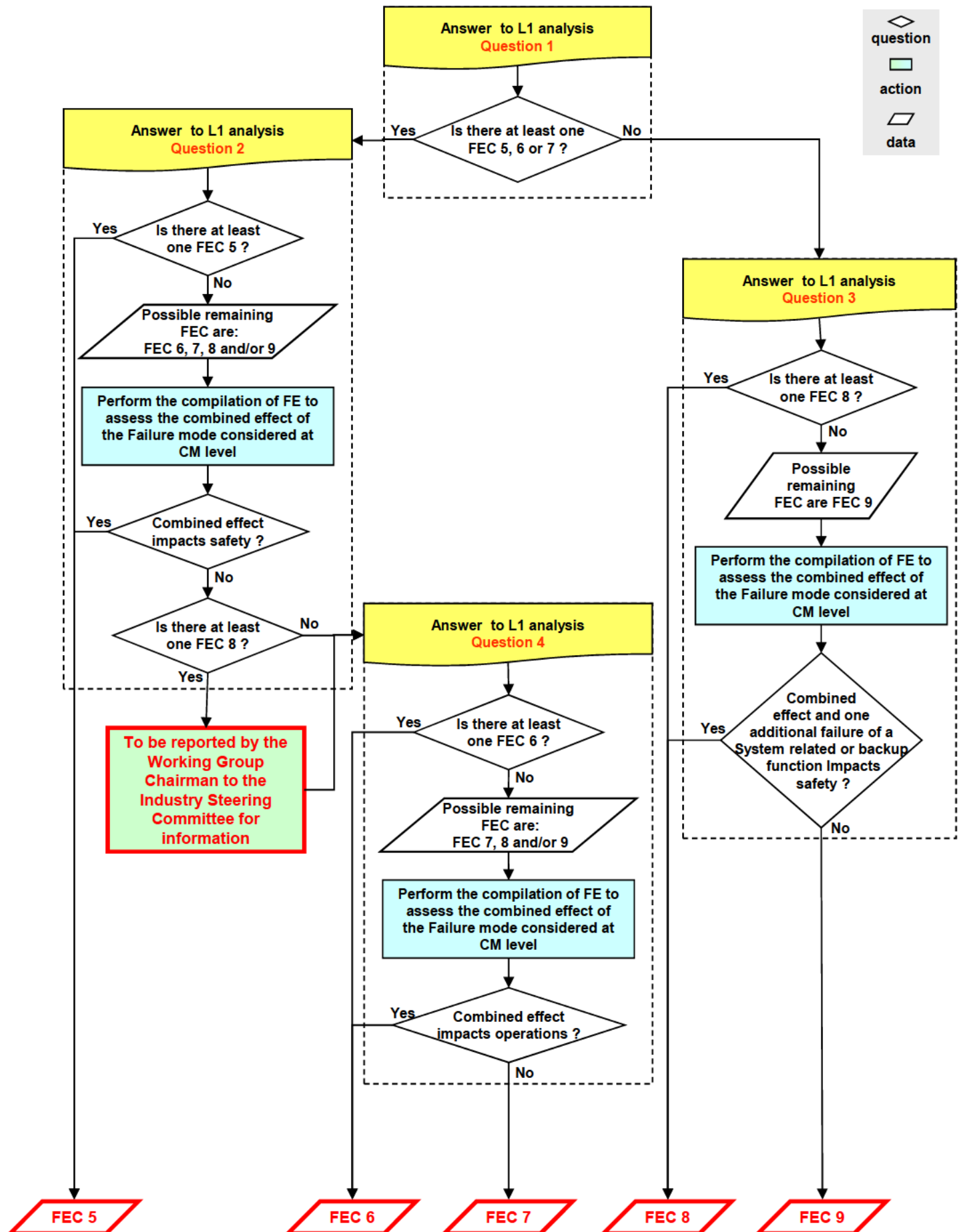
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MSG-3 Analysis - Systems/Powerplant		Level 1 Analysis			
FUNCTION(F)	1	FUNCTIONAL FAILURE (FF)	1A	FAILURE EFFECT (FE)	1A1
To compute the hosted applications (Application A, Application B).		Inability to compute all the hosted applications.		See the exhaustive list of FE in the DSA. (See table 'CM-1 & CM-2 Consequences-of-failure' matrix: total loss of CM-1 or CM-2)	
<div>1<div>Is the occurrence of a functional failure evident to the operating crew during the performance of their normal duties?</div><div><div>YES</div><div>NO</div></div><div>2<div>Does the functional failure or secondary damage resulting from the functional failure have a direct effect on operating safety?</div><div><div>YES</div><div>NO</div></div><div>3<div>Does the combination of a hidden functional failure and one additional failure of a system related or back-up function have an adverse effect on operating safety?</div><div><div>YES</div><div>NO</div></div><div>4<div>Does the functional Failure have a direct adverse effect on operating capability?</div><div><div>YES</div><div>NO</div></div><div><div><div><div>YES</div><div>NO</div></div><div><div>YES</div><div>NO</div></div></div><div><div><div>SAFETY</div><div>5</div></div><div><div>OPERATIONAL</div><div>6</div></div><div><div>ECONOMIC</div><div>7</div></div><div><div>SAFETY</div><div>8</div></div><div><div>NON-SAFETY</div><div>9</div></div></div><div><div>EVIDENT EFFECTS</div><div>HIDDEN FUNCTION EFFECTS</div></div></div></div></div></div></div>		<div>1) YES : The failure will be evident to flight crew because it causes at least one evident functional failure for the hosted applications. (See table 'FEC distribution at CM level': Total loss of CM-1 or CM-2)</div> <div>2) NO : The failure has no direct effect on operating safety, because other CM is still available to perform the function. (FEC 8 is selected in source MSI due to ...).</div> <div>4) YES : Operating capability is affected because corrective action has to be taken prior to further dispatch. (See table 'FEC distribution at CM level': Total loss of CM-1 or CM-2)</div> <div>Failure Effect Category 6 was selected</div>			
Applicability:					
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MSG-3 Analysis - Systems/Powerplant		Level 1 Analysis			
FUNCTION(F)	2	FUNCTIONAL FAILURE (FF)	2A	FAILURE EFFECT (FE)	2A1
To provide the hosted applications (Application A, Application B) with the necessary resources.		Inability to provide the hosted applications with all the AFDX data (input and output).		See the exhaustive list of FE in the DSA. (See table 'CM-1 or CM-2 Consequences-of-failure' matrix: Loss of AFDX input and output data of CM-1 or CM-2)	
<div><div>1</div><div>Is the occurrence of a functional failure evident to the operating crew during the performance of their normal duties?</div><div><div>YES</div><div>NO</div></div><div>2</div><div>Does the functional failure or secondary damage resulting from the functional failure have a direct effect on operating safety?</div><div><div>YES</div><div>NO</div></div><div>3</div><div>Does the combination of a hidden functional failure and one additional failure of a system related or back-up function have an adverse effect on operating safety?</div><div><div>YES</div><div>NO</div></div><div>4</div><div>Does the functional Failure have a direct adverse effect on operating capability?</div><div><div>YES</div><div>NO</div></div><div><div><div>YES</div><div>NO</div></div><div><div>YES</div><div>NO</div></div></div><div><div><div>SAFETY</div><div>5</div></div><div><div>OPERATIONAL</div><div>6</div></div><div><div>ECONOMIC</div><div>7</div></div><div><div>SAFETY</div><div>8</div></div><div><div>NON-SAFETY</div><div>9</div></div></div><div><div>EVIDENT EFFECTS</div><div>HIDDEN FUNCTION EFFECTS</div></div></div>		<div><div>1) YES :</div><div>The failure will be evident to flight crew because it causes at least one evident functional failure for the hosted applications. (See table 'FEC distribution at CM level': Loss of AFDX input and output data of CM-1 or CM-2)</div></div> <div><div>2) NO :</div><div>The failure has no direct effect on operating safety, because other CM is still available to perform the function. (FEC 8 is selected in source MSI due to ...).</div></div> <div><div>4) YES :</div><div>Operating capability is affected because corrective action has to be taken prior to further dispatch. (See table 'FEC distribution at CM level': Loss of AFDX input and output data of CM-1 or CM-2)</div></div> <div><div>Failure Effect Category 6 was selected</div></div>			
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OEM Example #2

EC175		Maintenance program – Systems & Powerplant				Data sheet B Function failure analysis	
FUNCTION		FUNCTIONAL FAILURE		FAILURE EFFECT		FAILURE CAUSE	
F NR	Normal characteristic action of the item	FF NR	How the item fails to perform its functions	FE NR	Results of the functional failure	FC NR	Why the functional failure occurs
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Systems and Powerplant analysis – Function failure analysis

III.4.2. Specific case of highly integrated electronic devices selected as MSI

For highly integrated electronic devices (HIED), in which a large number of signals are generated, converted or processed, recorded and/or displayed, a specific method is implemented to address:

- Specific functions hosted within these HIED
- Functions of other MSI to which the HIED contributes (referred to hereafter as “distributed functions”)
- Functional redundancies between HIED, hardware partitioning, duplication of input/output channels and reconfiguration management in case of failure
- Number of functions potentially impacted by a failure of a single HIED

This specific methodology impacts both Data Sheet A (item description) and Data Sheet B (Function Failure Analysis) in this First part. It also impacts Level 1 analysis that will be detailed further (refer to § III.5).

III.4.2.1. Distributed functions

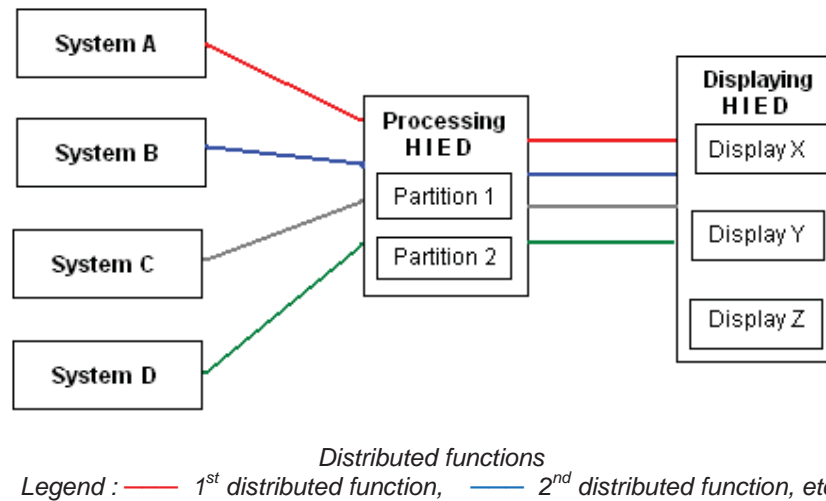
A function is considered as distributed when its potential failure causes are split between components belonging to different Maintenance Significant Items. This is for instance the case when equipment from a first MSI sends some information to a second MSI, which sends synthetic information to a display device which belongs to a third MSI.

In the following example, there are four systems (or MSI) on the left of the figure, providing data to a first HIED in charge of signal or data processing, which sends data to a second HIED acting as a display system.

The four display functions corresponding to the four systems A, B, C, D are distributed ones. They can be lost in case of a failure of the system A, B, C, D itself, of a failure of the processing HIED or of a failure of the display HIED.

However, if the processing HIED is partitioned in two independent and functionally identical channels with an automatic reconfiguration process and duplicated input / output channels, a complete failure of both partitions or channels of the HIED cannot be considered as a single failure, leading to a complete loss of the functions.

The same type of question arises if the display HIED includes several redundant screens coupled to functionally independent input channels.



Therefore, the function failure analysis (data sheet B) of distributed functions must be carried out with a specific policy and some specific rules. Other policy and rules concerning Level 1 analysis on HIED are defined in § III.5.3 on page 67.

III.4.2.2. MSI Breakdown and distributed functions

Functions being defined at MSI level, distributed functions cannot be addressed in a given Systems and Powerplant report.

In the example above, each distributed function which is represented in the diagram would be split in at least three functions at MSI level:

- At least one function in the MSI on the left (data generation functions)
- At least one function within the MSI Processing HIED (data processing functions)
- At least one function in the MSI Displaying HIED (data display functions)

III.4.2.3. Policy for Distributed function breakdown regarding MSI breakdown

The names of the functions defined at MSI level but which are parts of a distributed function shall be easy to match at each step (or MSI) of the distributed function. In the example above, the functions could be (for instance):

- For system A:
 - provide processing HIED with system A status
(this function is considered as an input function for the HIED)
- For Processing HIED:
 - process system A status data
(this function is considered as a processing HIED function)
- For Displaying HIED:
 - display system A status
(this function is considered as a displaying HIED function)

It must be remembered that these input or HIED functions are parts of a distributed function: this modifies the failure effect assessment and the failure cause analysis of the functional failure analysis.

In this table, there should be one HIED function per input function, so that the distributed function can be easily followed and reconstituted.

Note that, in the case of a distributed function divided in more than two sub-functions (provide data, pre-process data, process data, display data), all the sub-function will not be in the same table since they will be in three HIED Systems and Powerplant analysis reports (pre-processing HIED, processing HIED, Displaying HIED). The mapping can be done from the input functions.

Step 2: HIED mapping

In several cases, the failure causes defined in the Data Sheets B of the input MSI group failures of several elementary components. For instance, a failure cause like "Failure of micro switches of cockpit and sliding doors" groups the failure of:

- Cockpit pilot door micro switch
- Cockpit copilot door micro switch
- Right sliding door micro switch
- Left sliding door micro switch

Each of these components (or sources of information) is connected to one or more HIED.

The Step 2 consists in:

- Listing all the **components** (of the input MSI) contributing to each failure cause
- Cross-indexing them with the HIED (or functionally redundant components of HIED) they are functionally connected to

In the following example, Failure Causes and the corresponding components of the input MSI are in the line headers, and the HIED are in the column headers:

MSI Ref	FC NR	Component	Pre-processing HIED		Processing HIED 1		Processing HIED 2		Displaying HIED			
			LH	RH	Partition 1	Partition 2	Partition 1	Partition 2	Screen 1	Screen 2	Screen 3	Screen 4
CC-SS	1A1-1	Component 1			X	X			X	X	X	X
CC-SS	2A1-1	Component 2					X	X	X	X	X	X
CC-SS	2A1-1	Component 3			X	X			X	X	X	X
CC-SS	3A1-1	Component 4					X	X	X	X	X	X
CC-SS	3A1-1	Component 5			X	X			X	X	X	X
CC-SS	4A1-1	Component 6	X		X	X	X	X	X	X	X	X
CC-SS	4A1-1	Component 7		X	X	X	X	X	X	X	X	X
CC-SS	6A1-1	Component 8				X			X	X	X	X
CC-SS	6A1-1	Component 9			X				X	X	X	X
CC-SS	6A1-1	Component 10						X	X	X	X	X
CC-SS	6A1-1	Component 11					X		X	X	X	X

Systems and Powerplant analysis – HIED, Step 2

This table is included in the Data Sheet A.

III.4.2.5. HIED Functional Failure Analysis

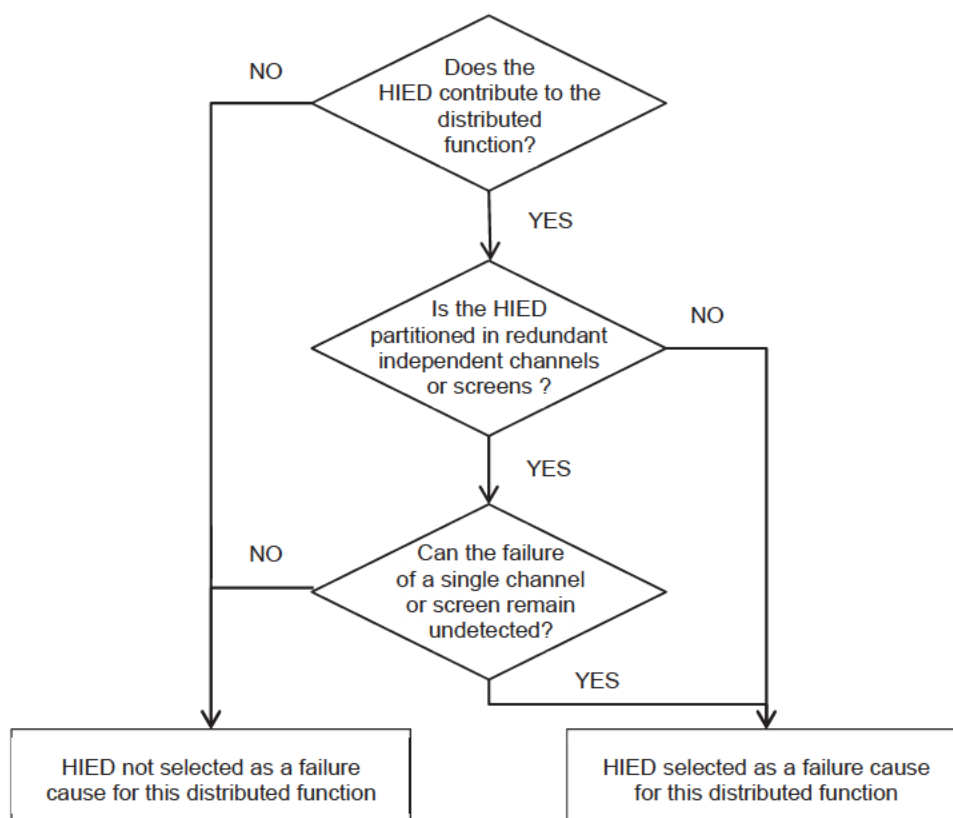
The tables populated here above (§ III.4.2.4, Step 2) are used to identify possible failure causes of each distributed function to which the HIED contributes.

In the above example, both HIED 1 and HIED 2 shall be considered as failure causes for Function 1, given that their failure prevents the information sent by Components 1.1 and 1.2 to be transmitted, processed and displayed. This is independent from the detectability of a failure of one of these HIED.

In the same example, given that HIED 3 is partitioned in two independent, functionally redundant channels, the logic depends on the detectability of a failure of the channels:

- If failures of the channels are not monitored, a failure of one partition may occur and remain undetected, as a hidden failure, so the HIED 3 shall be selected as failure cause for Function 1
- If failures of the two partitions are monitored, then no failure of one partition can remain undetected. The failure of a single partition has no other impact on the function than a loss of processing redundancy.

Besides this example, the general logic is the following:



Systems and Powerplant – selection logics of failure causes on HIED

The results of this logics are presented in a tabular form, in which a cross is put in the column “HIED FC” in front of each component selected as a failure cause:

MSI Ref	FC NR	Component	Processing HIED 1		Processing HIED 2		HIED FC
			Partition 1	Partition 2	Partition 1	Partition 2	
CC-SS	1A1-1	Component 1	X	X			
CC-SS	2A1-1	Component 2			X	X	
CC-SS	2A1-1	Component 3	X	X			
CC-SS	3A1-1	Component 4			X	X	
CC-SS	3A1-1	Component 5	X	X			
CC-SS	4A1-1	Component 6	X	X	X	X	
CC-SS	4A1-1	Component 7	X	X	X	X	
CC-SS	6A1-1	Component 8		X			X
CC-SS	6A1-1	Component 9	X				X
CC-SS	6A1-1	Component 10				X	X
CC-SS	6A1-1	Component 11			X		X

This table is included in Data Sheet A.