Model-based Architecting and Optimization of Distributed Integrated Modular Avionics

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Nomenclature

Symbols

Caligraphic Symbols

Symbol	Unit	Description
$\mathcal{C}$		Capabilities
$\lvert\mathcal{C}\rvert$		Number of capabilities per device
$\mathcal{D}$		Devices
$\lvert\mathcal{D}\rvert$		Number of devices
$\mathcal{E}$		Power source
$\mathcal{I}$		Installation locations
$\lvert\mathcal{I}\rvert$		Number of installation locations
$\mathcal{J}$		Cable route joints
$\mathcal{K}$		Device types (part number)
$\lvert\mathcal{K}\rvert$		Number of device types
$\mathcal{L}$		Links
$\mathcal{N}$		Network comprising switches and links $\mathcal{N} = \{\mathcal{D}^{\text{Switch}}, \mathcal{L}\}$
$\mathcal{P}$		Peripherals
$\mathcal{Q}$		Peripheral wires connecting a DIMA device to peripherals
$\mathcal{R}$		Resources types
$\lvert\mathcal{R}\rvert$		Number of device resource types
$\mathcal{S}$		Signals
$\mathcal{T}$		Tasks
$\lvert\mathcal{T}\rvert$		Number of tasks
$\mathcal{U}$		Cable Routes
$\mathcal{W}$		Wire types

Gothic Symbols

Symbol	Unit	Description
$\mathfrak{A}$		Atomic constraint
$\mathfrak{D}$		Devices constraint
$\mathfrak{I}$		Installation location constraint
$\mathfrak{L}$		Latency constraint
$\mathfrak{P}$		Peripheral constraint
$\mathfrak{S}$		Segregation constraint
$\mathfrak{E}$		Power constraint

Greek Symbols

Symbol	Unit	Description
λ	$\frac{1}{\mathrm{s}}$	Failure rate
ρ		Installation resources
Φ		Installation location resources types
$\lvert\Phi\rvert$		Number of installation resource types

Latin Symbols

Symbol	Unit	Description
c	\$	Costs
$\hat{c}$	$\frac{\$}{\mathrm{m}}$	Specific cost of cables
$\acute{c}$	$\frac{\$}{\mathrm{s}}$	Specific cost per time
d		Device limitations in providing resources
l	m	Length or distance
m	kg	Mass
$\hat{m}$	$\frac{\mathrm{kg}}{\mathrm{m}}$	Specific mass of cables
p		Propability
r		Device resources
$\lvert r \rvert$		Number of resource for all device types
$\lvert r_{\mathcal{K}} \rvert$		Number of resource for a device type
t	s	Time
$\left\lvert x^{\mathcal{D}} \right\rvert$		Number of devices assignment possibilities
$\left\lvert x^{\mathcal{T}} \right\rvert$		Number of task assignment possibilities

Abbreviations

Abbrv.		Description
A		
AADL	=	Architecture Analysis and Design Language
ADCN	=	Aircraft Data and Communication Network
AFDX	=	Avionics Full DupleX switched ethernet
AIMS	=	Airplane Information and Management System
API	=	Application Programming Interface
AS	=	Avionics Server → CPM
ATA	=	Air Transport Association
ATM	=	Anyone-To-Many
B		
BAG	=	Bandwidth Allocation Gap → AFDX
BAS	=	Bleed-Air System
BCD	=	Binary Coded Decimal
BP	=	Binary Programming (Program)
C		
CAN	=	Controller Area Network
CCE	=	Concurrent Configuration Engineering
CCS	=	Common Core System
COTS	=	Commercial-Off-The-Shelf
CPM	=	Core Processing Module
CP	=	Combined Protocol → A629
CPIOM	=	Core Processing Input and Output Module
CRDC	=	Common RDC
CSP	=	Constraint Satisfaction Problem
D		
DAL	=	Design Assurance Level
DIMA	=	Distributed Integrated Modular Avionics
DME	=	Distribute Modular Electronics
DSP	=	Digital Signal Processor

Abbrv.		Description
E		
E/E	=	Electrical and Electronic
EIS	=	Entry Into Service
EMF	=	Eclipse Modeling Framework
EMI	=	ElectroMagnetic Interference
EPTAS	=	Efficient PTAS
F		
FA	=	Federated Avionics
FDS	=	Fire Detection System
FIFO	=	First In First Out
FTU	=	Fault Tolerant Unit → TTP
FPTAS	=	Fast PTAS
G		
GAP	=	General Assignment Problem
GPM	=	General Processing Module
H		
HP	=	High-Performance → CPM
I		
I/O	=	Input/Output
IMA	=	Integrated Modular Avionics
IOM	=	Input and Output Module
IP	=	Integer Programming (Program) Internet Protocol
IPC	=	Initial Provisioning Costs
L		
LP	=	Linear Programming (Program)
LSP	=	Lightning Strike Protection

Abbrv.		Description
M		
MAF	=	MAjor (time) Frame → A653
MEL	=	Minimum Equipment List
MILP	=	Mixed Integer Linear Programming (Program)
MIPS	=	Million Instructions Per Second
MMEL	=	Master Minimum Equipment List
MO	=	Multi-Objective
MOIP	=	Multi-Objective Integer Programming (Program)
MTBF	=	Mean Time Between Failure
MTBUR	=	Mean Time Between Unscheduled Removal
MTTR	=	Mean Time To Repair
N		
NFF	=	No Failure Found Rate
NVM	=	Non-Volatile Memory
O		
OHDS	=	OverHeat Detection System
OIC	=	Operational Interruption Costs
OS	=	Operating System
P		
PP	=	Pin Programming
PS	=	Pneumatic System
PTAS	=	Polynomial-Time Approximation Scheme
PTP	=	Pear-To-Pear
Q		
QP	=	Quadratic Programming (Program)
QCQP	=	Quadratically Constrained QP
R		
RDC	=	Remote Data Concentrator
RIU	=	Remote Interface Unit
RPIOM	=	Remote Processing and I/O Module
RTOS	=	Real-time Operating System

Abbrv.		Description
S		
SAT	=	(Boolean) SATisfiability
SDI	=	Source/Destination Identifier → A429
SG	=	Synchronization Gap → A629
SOS	=	Special-Ordered-Sets
SSC	=	Ship-Set Costs → A429
SSM	=	Status/Sign bits → A429
T		
TC	=	Time-Critical → CPM
TI	=	Transmit Interval → A629
TDMA	=	Time Division Multiple Access
TLM	=	Transaction Level Model → SystemC
TTP	=	Time Triggered Protocol
U		
UDP	=	User Datagram Protocol
V		
V&V	=	Verification and Validation
VCS	=	Ventilation Control System
VL	=	Virtual Link → AFDX
W		
WCET	=	Worst Case Execution Time