



U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – C5ISR CENTER

MORA V2.5 Training Course: Session Two – Signal Resource Overview
09 March 2023

MORA Architecture Working Group (AWG)

RTI Directorate / CT Division / ITA Branch

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Center DRAS # 23-319



MORA TRAINING SYLLABUS



Session One: Introduction to MORA (DIST A): (2 Hours)

- Part 1: Introduction to MORA (Motivation, Objectives, Foundation, Core Features, History/Future)
- Part 2: MORA Formal Definitions (Devices, Resources, Ports)
- Part 3: MORA Client Control Structure (Device Level, Processing Resource and Signal Resource)

Session Two: Signal Resource Overview (DIST A): (2 Hours)

- Part 4: Signal Resource Component Types (Key Interactions)
- Part 5: MORA Signal Resource Profile (MSRP) (Electronic RF Datasheet)
- Part 6: Summary for the MORA Implementation of VITA 49.2 (limitations, clarifications, additions)

Session Three: Signal Resource Interactions and Networks (DIST A): (4 Hours)

- Part 7: VDB Management Interactions (MORA Device, MORA Signal Resource Manager)
- Part 8: ML2B RF Layer Data, Context and Command Interactions (MDM Type 1)
- Part 9: Operations interactions (MDM Types 2-7)
- Part 10: Network Environments (VDB and ML2B)

Session Four: (DIST C): (2 Hours)

- Part 11: (DIST C)
- Part 12: (DIST C)
- Part 13: (DIST C)

Session Five: (DIST C): (2 Hours)

- Part 14: MORA Processing Resources (DIST A)
- Part 15: (DIST C)
- Part 16: (DIST C)



MORA TRAINING COURSE

SESSION TWO



- Part 4: Signal Resource Component Types
 - MORA Device
 - MORA Signal Resource Manager
 - MORA Signal Port Manager
- Part 5: MORA Signal Resource Profile (MSRP)
 - MSRP Overview
 - MORA Device and Waveform
 - Signal Port / Signal Port Description / Signal Port Performance Data
 - Connections (External / Internal / Reference)
 - Antennas / Manifolds
 - Switch Group
 - Configuration Parameters
- Part 6: Summary for the MORA Implementation of VITA 49.2
 - Limitations
 - Definitions
 - Additions



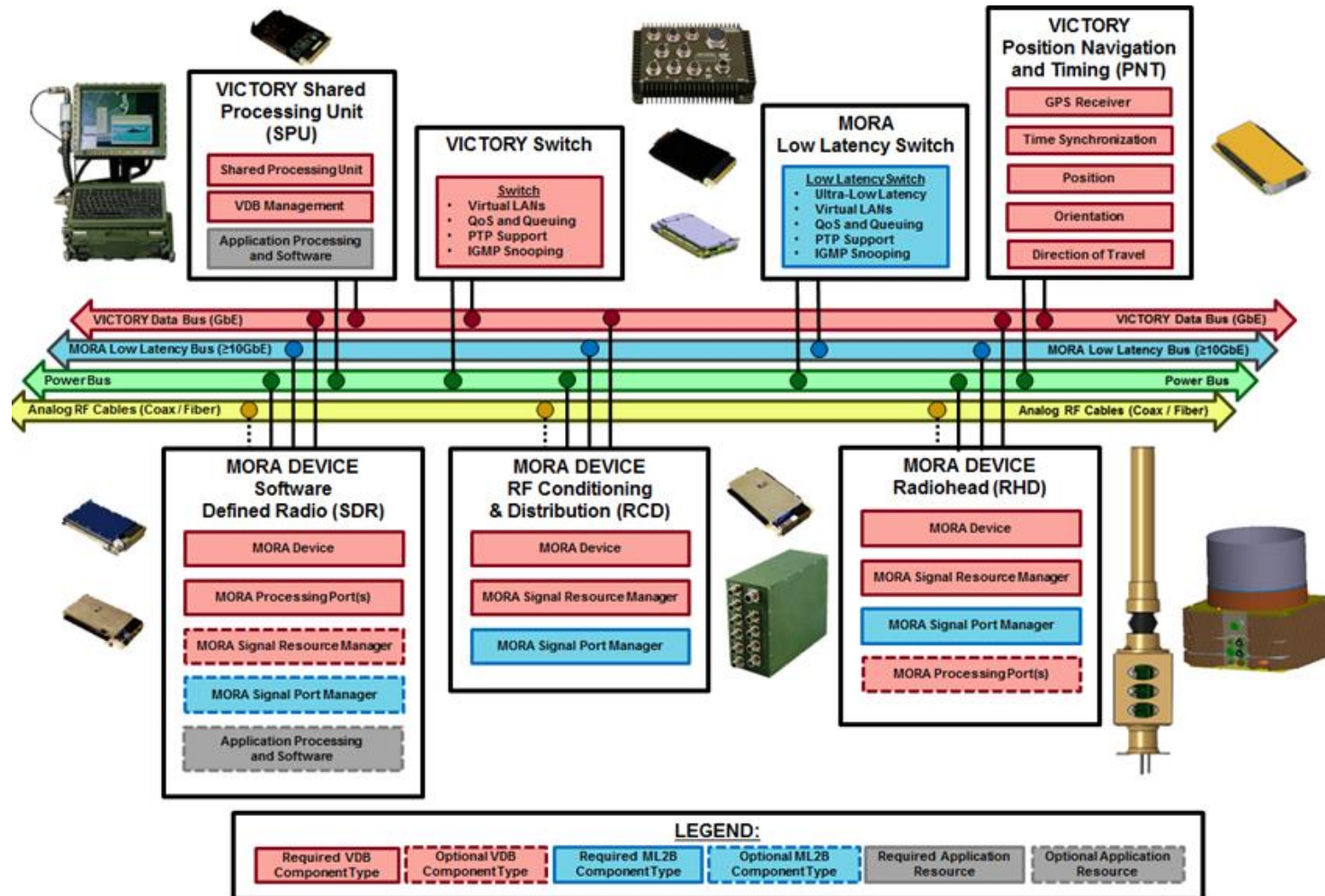
Part 4: Signal Resource Component Types



COMPONENT TYPES



MORA AND VICTORY COMPONENT TYPES





COMPONENT TYPES



VICTORY COMPONENT TYPES

The table below contains services from the VICTORY Standard Specification that are **recommended** on MORA platforms to satisfy typical functional / performance requirements.

Table 5 Minimum Recommended VICTORY Component Types

Component Type	Spec Tag
Time Synchronization Service	VT50000-V1.7
Position Service	VT50100-V1.9
GPS Receiver	VT61000-V1.9
Orientation Service	VT50200-V1.9
Direction of Travel Service	VT50300-V1.9
Switch	VT50900-V1.9
Authentication Service	VT50401-V1.9
Policy Enforcement Service	VT50600-V1.9
Policy Decision Service	VT50500-V1.9
Policy Store Service	VT50700-V1.9
Attribute Store Service	VT50800-V1.9



COMPONENT TYPES



CURRENT SIGNAL RESOURCE COMPONENT TYPES:

- MORA Device <MT92010-V2.5>
- MORA Signal Resource Manager <MT92013-V2.5>
- MORA Signal Port Manager <MT92016-V2.5>

CURRENT INFRASTRUCTURE COMPONENT TYPES:

- Low Latency Switch <MT91010-V2.5>

FUTURE PROCESSING RESOURCE COMPONENT TYPES:

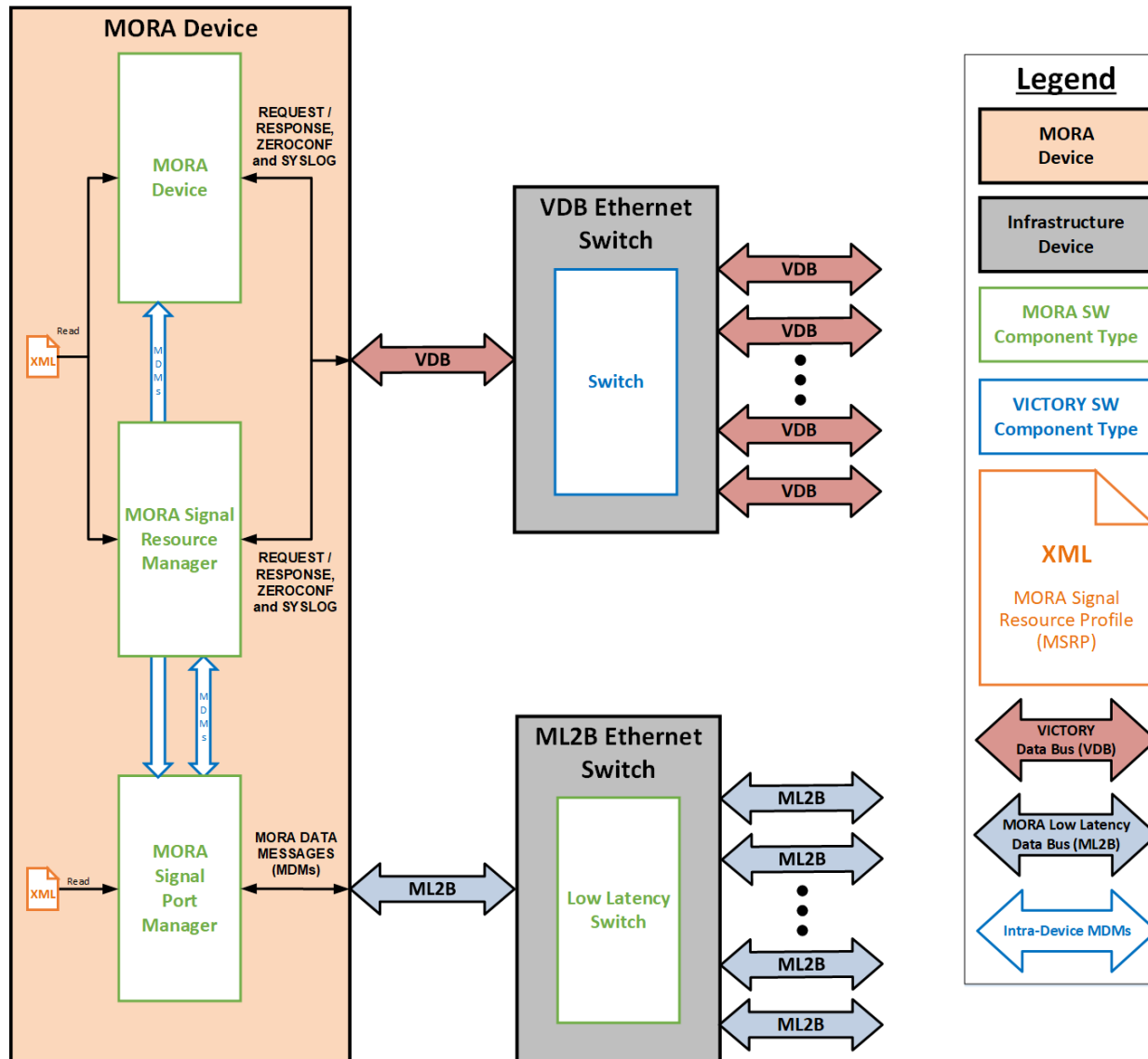
- Direction Finding Engine <MT92020-V3.0>
- RF Spectrum Sensor <MT92030-V3.0>



MORA SOFTWARE



Implementation of Component Types within a MORA Device for Signal Resources



Alternate Proxy Implementation of Signal Resources





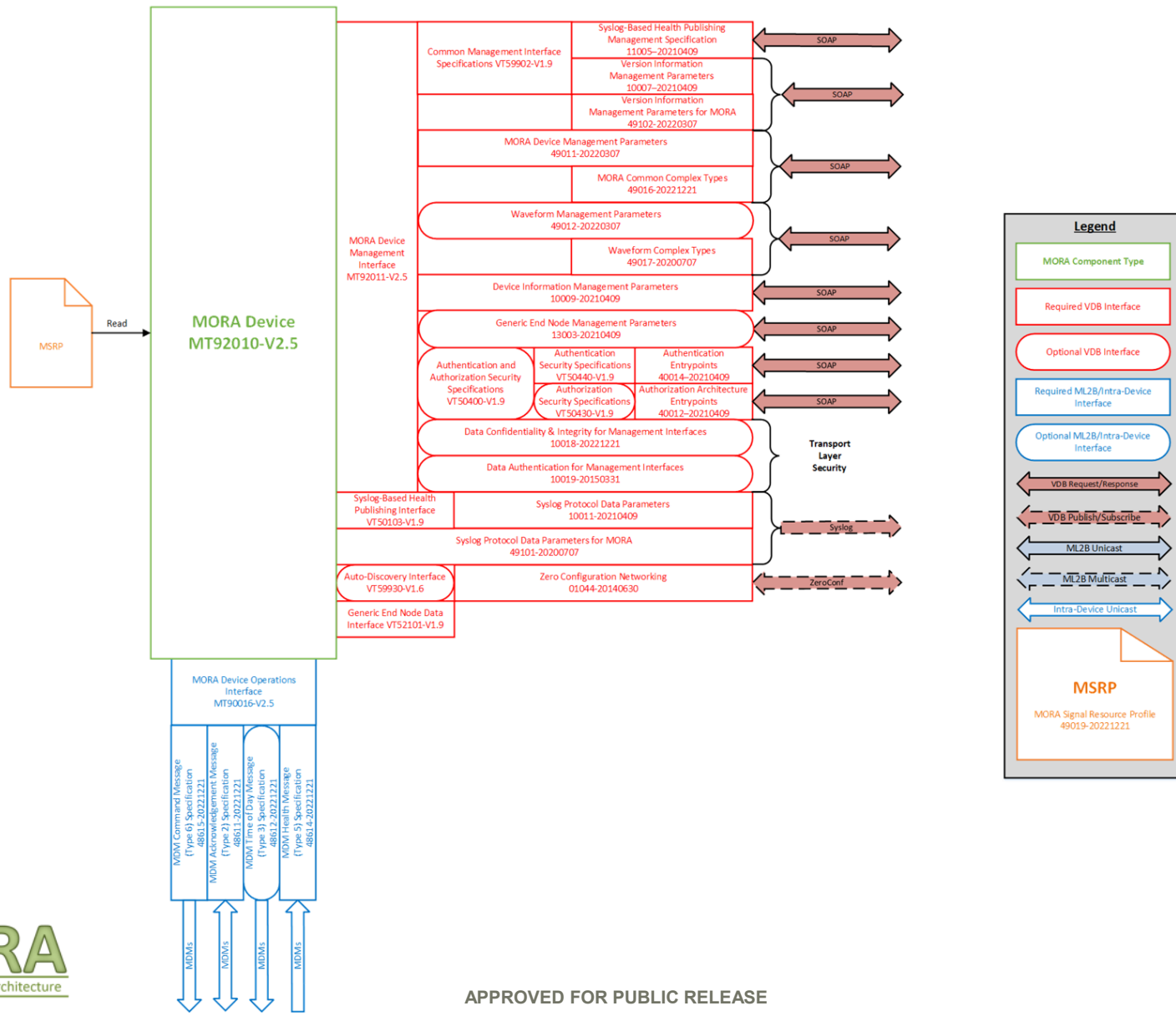
MORA Device Component Type



MORA DEVICE COMPONENT TYPE



MORA Device Component Type Message Interactions





MORA DEVICE CORE OPERATIONS



Version Information Management Parameters (Operations):

- Interface Type (get)
- Interface Standard Version (get)
- Interface SOAP Components (get)

MORA Device Management Parameters (Operations):

- Device Description (get)
- Device Status (get)
- File (push / pull / get list / delete)
- Current MORA Configuration (get / get available / set)
- Built-In Test Results (run / get)
- Command (send)

Device Information Management Parameters (Operations):

- Manufacturer (get)
- Model (get)
- Equipment Identifier (get)

Generic End Node Management Parameters – **Optional** (Operations):

- Ethernet Interfaces (get)
- DHCP Enabled (get)
- Host Name (get / set)
- Date Time (get / set)
- Auto-Discovery Enabled (get / set)
- Display Blackout Enabled (get / set)
- Generic End Node (restart / standby / purge)

Waveform Management Parameters – **Optional** (Operations):

- Waveforms (get available)
- Waveform Operations (set current / get current / get available)



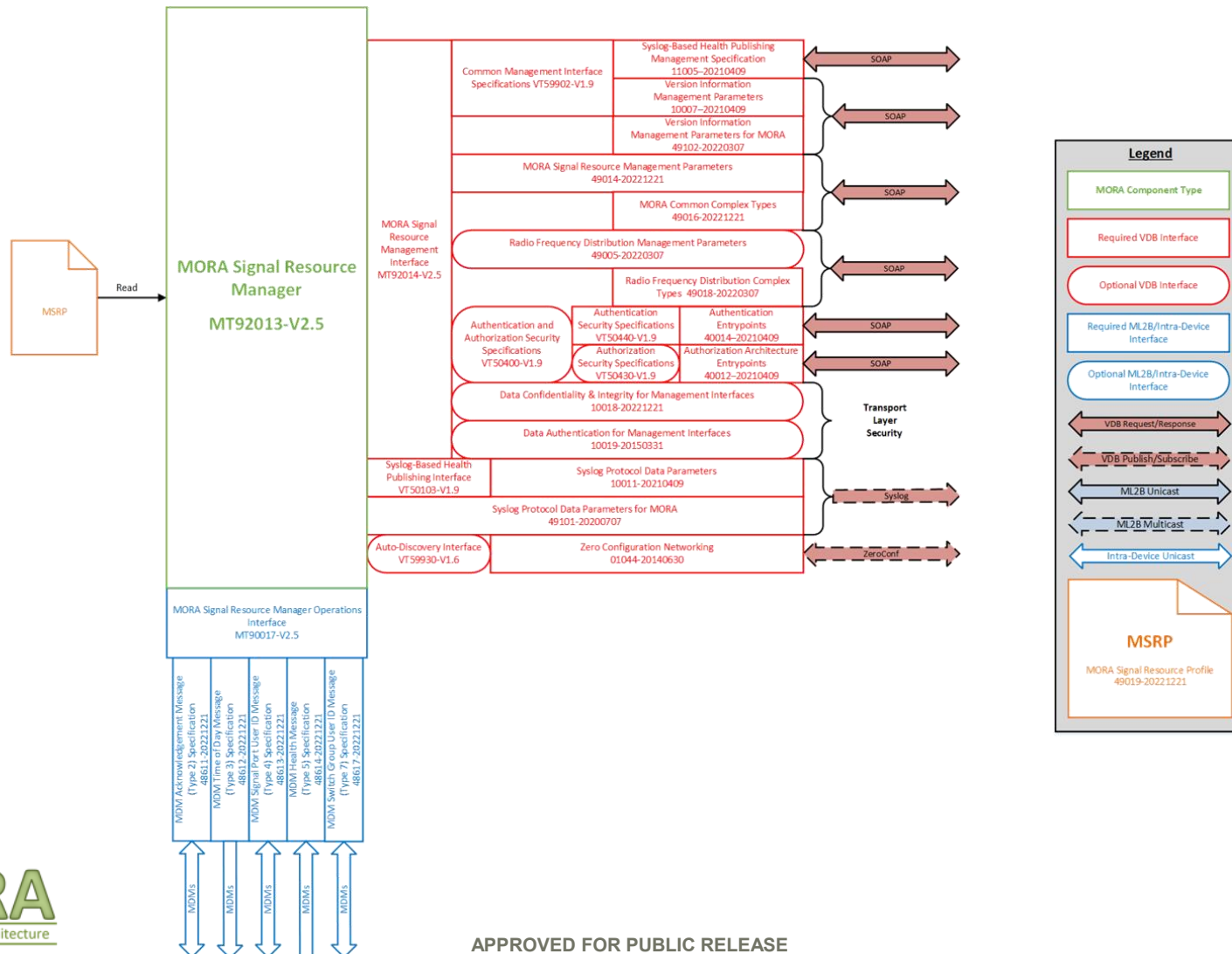
MORA Signal Resource Component Type



MORA SIGNAL RESOURCE COMPONENT TYPE



MORA Signal Resource Manager Component Type Message Interactions





MORA SIGNAL RESOURCE MANAGER CORE OPERATIONS



Version Information Management Parameters (Operations):

- Interface Type (get)
- Interface Standard Version (get)
- Interface SOAP Components (get)

Signal Resource Management Parameters (Operations):

- Signal Port (get / reserve / release)
- Signal Port Reservations (get)
- Signal Port Description (get)
- Signal Port Default Performance Data (get)
- Static External Connection Map (get)
- Static Internal Connection Map (get)
- Internal Reference Connections (get)
- Antenna Arrays (get)
- Manifold Bands (get)

RF Distribution Management Parameters - **Optional** (Operations):

- Switch Groups (get / reserve / release)
- Switch Group Reservations (get)



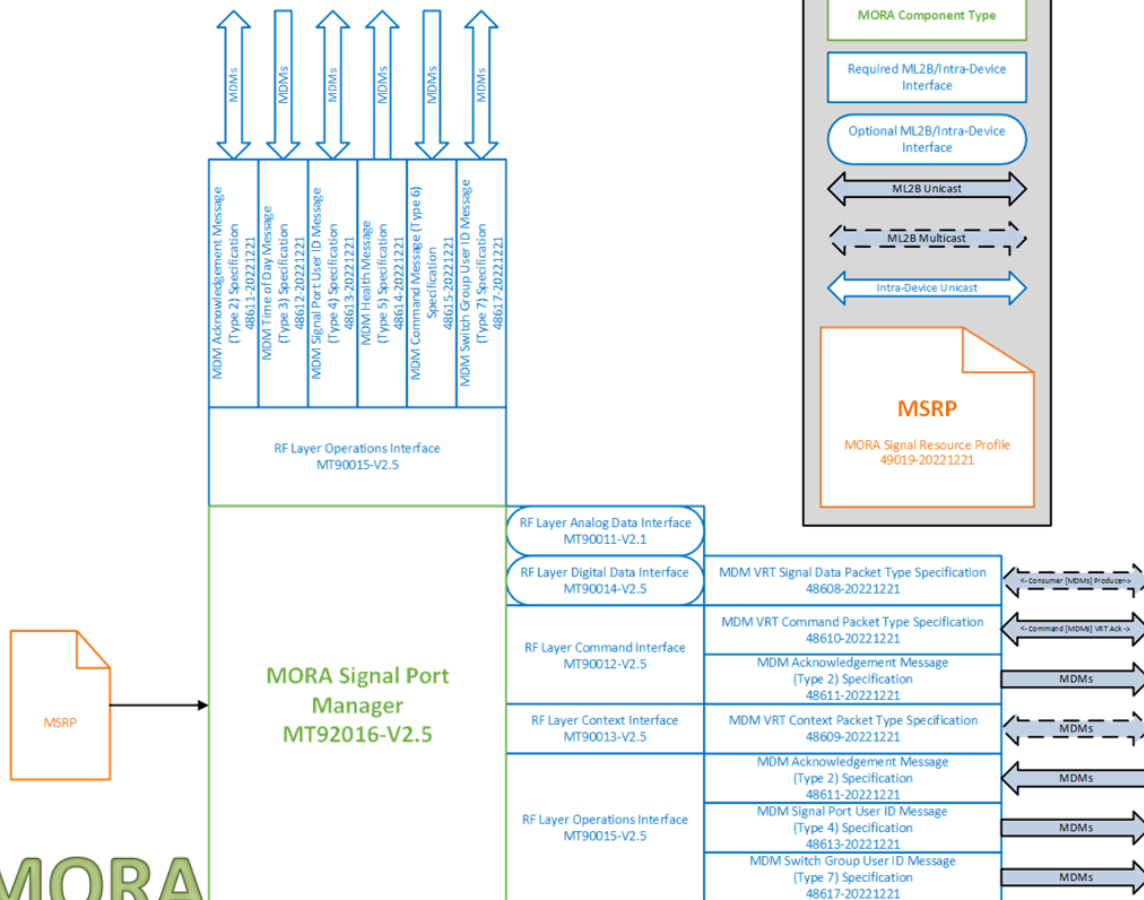
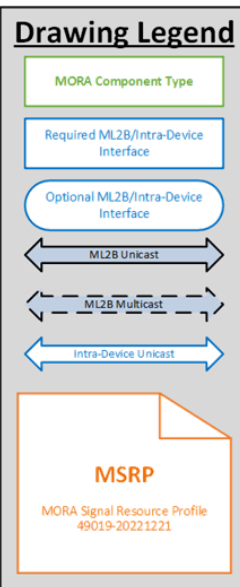
MORA Signal Port Manager Component Type



MORA SIGNAL PORT MANAGER COMPONENT TYPE



MORA Signal Port Manager Component Type Message Interactions (Full Implementation)



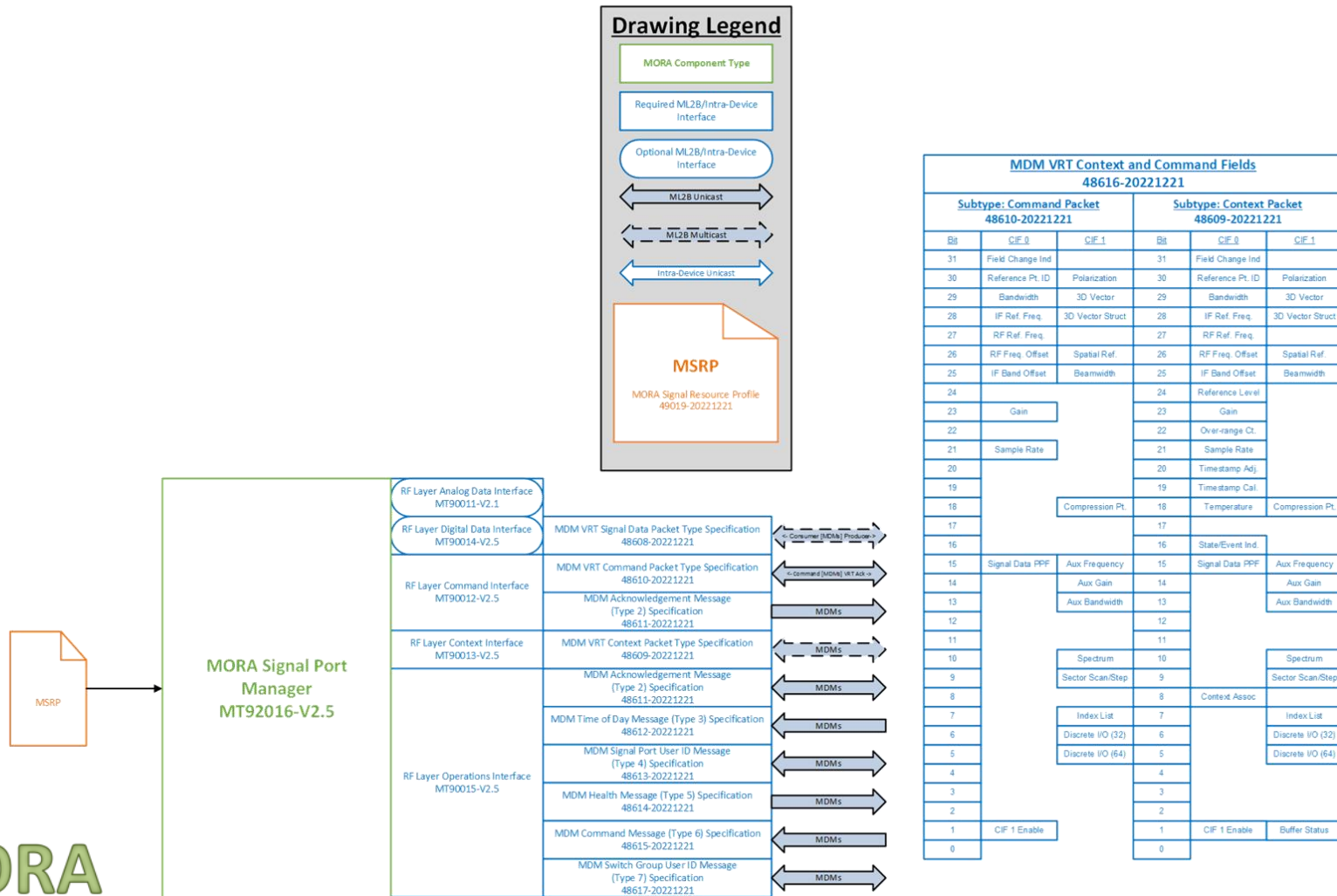
MDM VRT Context and Command Fields 48616-20221221					
Subtype: Command Packet 48610-20221221			Subtype: Context Packet 48609-20221221		
Bit	CIF.0	CIF.1	Bit	CIF.0	CIF.1
31	Field Change Ind		31	Field Change Ind	
30	Reference Pt. ID	Polarization	30	Reference Pt. ID	Polarization
29	Bandwidth	3D Vector	29	Bandwidth	3D Vector
28	IF Ref. Freq.	3D Vector Struct	28	IF Ref. Freq.	3D Vector Struct
27	RF Ref. Freq.		27	RF Ref. Freq.	
26	RF Freq. Offset	Spatial Ref.	26	RF Freq. Offset	Spatial Ref.
25	IF Band Offset	Beamwidth	25	IF Band Offset	Beamwidth
24			24	Reference Level	
23	Gain		23	Gain	
22			22	Over-range Ct.	
21	Sample Rate		21	Sample Rate	
20			20	Timestamp Adj.	
19			19	Timestamp Cal.	
18		Compression Pt.	18	Temperature	Compression Pt.
17			17		
16			16	State/Event Ind.	
15	Signal Data PFF	Aux Frequency	15	Signal Data PFF	Aux Frequency
14		Aux Gain	14		Aux Gain
13		Aux Bandwidth	13		Aux Bandwidth
12			12		
11			11		
10		Spectrum	10		Spectrum
9		Sector Scan/Step	9		Sector Scan/Step
8			8	Context Assoc.	
7		Index List	7		Index List
6		Discrete I/O (32)	6		Discrete I/O (32)
5		Discrete I/O (64)	5		Discrete I/O (64)
4			4		
3			3		
2			2		
1	CIF 1 Enable		1	CIF 1 Enable	Buffer Status
0			0		



MORA SIGNAL PORT MANAGER COMPONENT TYPE



MORA Signal Port Manager Component Type Message Interactions (Proxy Implementation)





MORA SIGNAL PORT MANAGER COMPONENT TYPE



- MORA Signal Port Manager Component Type consists of the following interfaces and the MORA Signal Resource Profile:

Table 18 MORA Signal Port Manager <MT92016-V2.5>

Spec Title	Spec Tag	Applicability
RF Layer Analog Data Interface	MT90011-V2.1	(1) Required
RF Layer Digital Data Interface	MT90014-V2.5	
RF Layer Command Interface	MT90012-V2.5	Required
RF Layer Context Interface	MT90013-V2.5	Required
RF Layer Operations Interface	MT90015-V2.5	Required
MORA Signal Resource Profile	49019-20221221, Pro	Required

(1) One or more of MT90011, MT90014 is Required

- The RF Layer Analog Data Interface is a hardware specification.
- The other four RF Layer interfaces are accomplished with the use of seven types of binary level MORA Data Messages (MDMs).



MORA SIGNAL PORT MANAGER

COMPONENT TYPE



- The RF Layer Command, RF Layer Context and RF Layer Digital Data interfaces are implemented using the MDM Type 1 VRT Messages.
- The RF Layer Command Interface and the RF Layer Operations Interface are unicast. The RF Layer Context and RF Layer Digital Data interfaces are multicast.
- The unicast RF Layer Command and RF Layer Operations interfaces can request a receipt acknowledge response in the form of an MDM Type 2 message.
- The MDM Type 1 Message payload construct is based on the MORA implementation of the V49.2 specification defined in chapter 6 of the MORA specification. A summary of the MORA limitations, clarifications and additions to V49.2 are summarized in another part of this MORA training course.



MORA SIGNAL PORT MANAGER COMPONENT TYPE



■ RF Layer Command Interface:

Table 20 RF Layer Command Interface <MT90012-V2.5>

Spec Title	Spec Tag	Applicability
MDM Protocol Specifications	MT96001-V2.5	Required
MDM Networking Specifications	MT96002-V2.5	Required
MDM VRT Message Structure Specification	48607-20221221, Pro	Required
MDM VRT Context and Command Fields Specification	48616-20221221, Pro	Required
MDM VRT Command Packet Type Specification	48610-20221221, Pro	Required
MDM Acknowledgement Message (Type 2) Specification	48611-20221221, Pro	Required
MORA Low Latency Bus Performance Specification	48201-20160131, Exp	(+) Recommended

(+) Experimental specifications are not included in compliance tests.



MORA SIGNAL PORT MANAGER COMPONENT TYPE



- RF Layer Context Interface:

Table 21 RF Layer Context Interface <MT90013-V2.5>

Spec Title	Spec Tag	Applicability
MDM Protocol Specifications	MT96001-V2.5	Required
MDM Networking Specifications	MT96002-V2.5	Required
MDM VRT Message Structure Specification	48607-20221221, Pro	Required
MDM VRT Context and Command Fields Specification	48616-20221221, Pro	Required
MDM VRT Context Packet Type Specification	48609-20221221, Pro	Required
MDM Multicast Dissemination Specification	48801-20221221, Pro	Required
MORA Low Latency Bus Performance Specification	48201-20160131, Exp	(+) Recommended

(+) Experimental specifications are not included in compliance tests.



MORA SIGNAL PORT MANAGER COMPONENT TYPE



- RF Layer Digital Data Interface

Table 22 RF Layer Digital Data Interface <MT90014-V2.5>

Spec Title	Spec Tag	Applicability
MDM Protocol Specifications	MT96001-V2.5	Required
MDM Networking Specifications	MT96002-V2.5	Required
MDM VRT Message Structure Specification	48607-20221221, Pro	Required
MDM VRT Signal Data Packet Type Specification	48608-20221221, Pro	Required
MDM Multicast Dissemination Specification	48801-20221221, Pro	Required
MORA Low Latency Bus Performance Specification	48201-20160131, Exp	(+) Recommended

(+) Experimental specifications are not included in compliance tests.



MORA SIGNAL PORT MANAGER COMPONENT TYPE



- RF Layer Operations Interface:

Table 23 RF Layer Operations Interface <MT90015-V2.5>

Spec Title	Spec Tag	Applicability
MDM Protocol Specifications	MT96001-V2.5	Required
MDM Acknowledgement Message (Type 2) Specification	48611-20221221, Pro	Required
MDM Time of Day Message (Type 3) Specification	48612-20221221, Pro	Required
MDM Signal Port User ID Message (Type 4) Specification	48613-20221221, Pro	Required
MDM Health Message (Type 5) Specification	48614-20221221, Pro	Required
MDM Command Message (Type 6) Specification	48615-20221221, Pro	Required
MDM Switch Group User ID Message (Type 7) Specification	48617-20221221, Pro	Required
MDM Networking Specifications	MT96002-V2.5	Optional*

* Required for MDMs transiting a network

- The unicast RF Layer Operations interface is accomplished with the use of six types of MDMs (Types 2-7).



MDM DATA ENCODING AND ENCAPSULATION



- MDM Encoding: Big-Endian
- MDM Encapsulation: UDP
- MDM on ML2B: UDP / IP / Ethernet
- MDM Structure / Header

Table 28 MDM Header Format

MDM Header
MDM Body

32-bits			
16-bits		16-bits	
8-bits	8-bits	8-bits	8-bits
MDM PREAMBLE			ACK
VERSION MAJ	VERSION MIN	MDM SEQUENCE NUMBER	
ML2B INTERFACE ID			
MDM TYPE		NUMBER OF MESSAGES	

- MDM Body Number of Data Messages / Data Message Size

MDM Packet Type Description	MDM Packet Type Number	Number of Data Messages in One Packet Payload	Data Message Size
VITA Radio Transport (VRT)	1	1	Variable Length
Acknowledgement	2	0	NA
Time of Day	3	1	Fixed - One Word
Signal Port User ID	4	1	Fixed - Twenty-Two Words
Health Status	5	1	Fixed - Two Words
Command	6	1	Fixed - Three Words
Switch Group User ID	7	1	Fixed - Fifteen Words



MORA SIGNAL PORT MANAGER COMPONENT TYPE



- MDM Networking Specifications: (deeper dive in Session Three)

Table 30 MDM Networking Specifications <MT96002-V2.5>

Spec Title	Spec Tag	Applicability
Low Latency Copper Data Physical and Data-Link Layer Specifications	MT91013-V2.4	(1) Required
Low Latency Fiber Data Physical and Data-Link Layer Specifications	MT91014-V2.1	
Standard for Ethernet Specification	48001-20221221, Pro	Required
Virtual LANs Specification	48002-20220414, Exp	(+) Required
Standard for Internet Protocol and User Datagram Protocol Specification	48005-20221221, Pro	Required
Jumbo Frame Packet Support Specification	48007-20221221, Pro	Required
MDM Traffic Marking Specification	48008-20220414, Exp	(+) Required

(+) Experimental specifications are not included in compliance tests.

(1) One or more of MT91013, MT91014 is Required



Part 5: MORA Signal Resource Profile (MSRP)



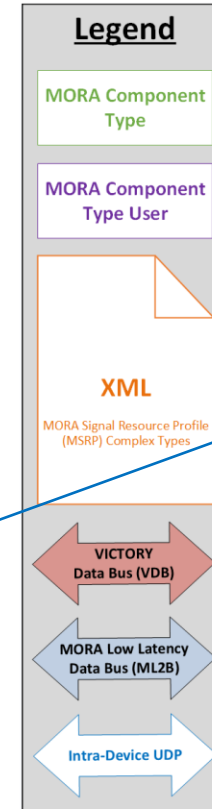
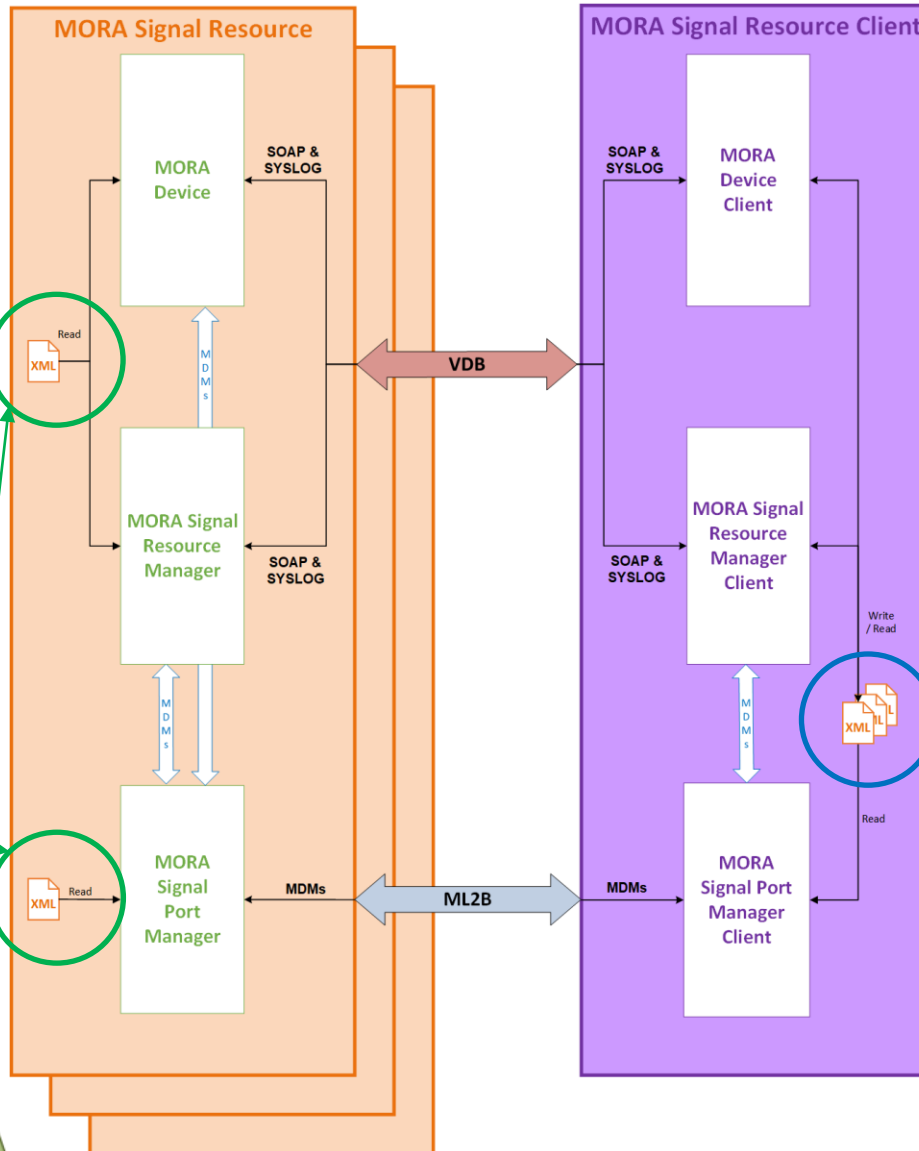
MSRP OVERVIEW



MORA Signal Resource SW Component Types

The MSRP is generated by the device OEM while the System Integrator modifies it for a specific system.

Two identical copies of the MSRP XML file reside within the signal resource device.



MSRP information is made available to the client through a series of message interactions. Only the portions of interest are built since not all profile information is applicable to all potential clients.



MORA SIGNAL RESOURCE PROFILE (MSRP)



– MORA Signal Resource Profile (MSRP) Regulations and Complex Types

5.7 MORA Signal Resource Profile <49019-20221221, Pro>

The establishment of a standardized MORA Signal Resource Profile (MSRP) enables portability for capabilities to be easily integrated across multiple systems. The MORA signal resource component type interfaces specify well defined message structures and over the wire behavior. The standardized MSRP defines a file data structure for a specific implementation's device level characteristics, signal resource attributes, and communication settings. This established file data structure allows multiple parties to view and edit profile content throughout the implementation process.

The implementation process starts with the original equipment manufacturer constructing the first MSRP file from a device perspective. This would include basic device level characteristics, detailed signal resource attributes, and some initial generic network settings for operational test purposes. Next, once the device is identified for use in a system integration, the system integrator would modify / update the MSRP from a system perspective. This would entail adding information on the device's external connections (analog signal ports) to other devices in the system as well as device level identifiers and waveforms. System specific updates would likely be made to the communication settings for both VDB and ML2B connections (static transport configurations including final URL/URI, MAC, IP, UDP Port, and MUI details). The MSRP implementation process is a key aspect that ultimately leads to program acceptance and accreditation of the system by the stakeholder.

The standardized MSRP also enables the MORA signal resource component types to support multiple profiles for selection at boot-up in devices that are approved for use in different physical locations (e.g., card slots) within a MORA system as well as across systems from different programs. Allowing devices to be preloaded with multiple approved system profiles simplifies the acquisition and provisioning for the stakeholder community while also allowing device manufacturers to maintain a lower mix of products while supporting a larger number of programs.

The standardization of the MSRP is specified through the declaration of a separate set of complex types named MORA Signal Resource Profile Complex Types. This set of complex types is organized to achieve efficient ingest at resource-side startup / boot and differs from other MORA specified sets of complex types that are organized in support of message interactions. There are some shared complex types between the complex type sets as well as some repurposed complex types. Additionally, the MSRP complex type includes configuration parameters for the resource-side that are related to component type behaviors and inter-component type interactions that are not exposed externally to clients.

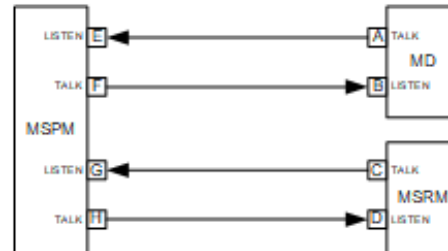
These inter-component type interactions are defined by the operation interfaces for each component type. The transport method of the operations interface MDMs can be directly addressable or can transit an intermediate appliance requiring knowledge of additional network socket parameters. [Figure 14](#) below depicts both methods and how the MSRP Configuration Parameters supports either method.



MORA SIGNAL RESOURCE PROFILE (MSRP)

MSRP Configuration Parameters Specification Support for Operations Interface Sockets

Operations Interface Directly Addressable Transport of Unidirectional Separated Lanes



Local Sockets:

A = MD TALK TO MSPM
B = MD LISTEN TO MSPM
C = MSRM TALK TO MSPM
D = MSRM LISTEN TO MSPM
E = MSPM LISTEN TO MD
F = MSPM TALK TO MD
G = MSPM LISTEN TO MSRM
H = MSPM TALK TO MSRM

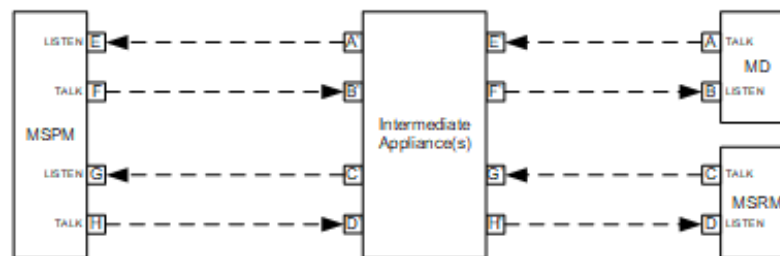
A ... H are component type local "sockets" for the operations interface which include:
MAC (RC for proxy)
IP (RC for proxy)
UDP Port (R)
MUI (R)

The MUI must be minimally unique to the component type level

If unidirectional or separated lanes are not desired, the following maximum consolidations are allowed:

A = B
C = D
E = F = G = H
A' = B' = C' = D'
E' = F' = G' = H'

Operations Interface Intermediary Transport using Unidirectional Separated Lanes



Local Sockets:

E = MSPM LISTEN TO MD
F = MSPM TALK TO MD
G = MSPM LISTEN TO MSRM
H = MSPM TALK TO MSRM

Intermediary Sockets:

A' = INTERMEDIARY MD TALK TO MSPM
B' = INTERMEDIARY MD LISTEN TO MSPM
C' = INTERMEDIARY MSRM TALK TO MSPM
D' = INTERMEDIARY MSRM LISTEN TO MSPM
E' = INTERMEDIARY MSPM LISTEN TO MD
F' = INTERMEDIARY MSPM TALK TO MD
G' = INTERMEDIARY MSPM LISTEN TO MSRM
H' = INTERMEDIARY MSPM TALK TO MSRM

Local Sockets:

A = MD TALK TO MSPM
B = MD LISTEN TO MSPM
C = MSRM TALK TO MSPM
D = MSRM LISTEN TO MSPM

A ... H are intermediate appliance "intermediary sockets" for the operations interface which include:
MAC (R)
IP (R)
UDP Port (R)



MORA SIGNAL RESOURCE PROFILE (MSRP)



– MORA Signal Resource Profile (MSRP) Regulations and Complex Types (con't)

5.7.1 MORA Signal Resource Profile Implementation Rules

1. The resource-side MORA Device, MORA Signal Resource Manager, and MORA Signal Port Manager component types shall implement the standardized MORA Signal Resource Profile as defined in the section titled “[MORA Signal Resource Profile Complex Types](#).”
2. The client-side may choose to utilize the standardized MORA Signal Resource Profile for storing and sharing discovered signal resource information obtained from request/response interactions across the client-side MORA component types.
3. The resource-side MORA Device, MORA Signal Resource Manager, and MORA Signal Port Manager component types shall use an identical MSRP file for a given device in a specific implementation.
4. The MORA MSRP file shall be static within a device's operating session and shall not be dynamically modified during the system's operating session by any message interactions.
5. MORA implementations shall provide a clearly documented method for programs to update and maintain all MSRP files on a device.
6. MORA implementations may permit MSRP files to be managed via the file operations described in the section titled “[MORA Device Management Parameters](#)” for files of Type “PROFILE” corresponding to a “[MORA File](#)” complex type.
7. A MORA implementation should support the storage of multiple MSRPs for scenarios where the device may migrate in different physical locations (e.g., card slots) within a MORA system as well as across systems from different programs, selecting the appropriate file on startup/restart.
8. A program should implement a system wide MSRP file naming convention that includes methods to identify:
 - Program name
 - MORA Signal Port Manager Operations Interface MUI (e.g., 12345)
 - Physical location in the system (e.g., Slot2)
 - System specific device name in the system (e.g., Alpha_Payload_Card)
 - Device major version
 - Device minor version
 - File major version
 - File minor version
 - File extension (e.g., xyz.msrp)



MORA SIGNAL RESOURCE PROFILE (MSRP)



– MORA Signal Resource Profile (MSRP) Regulations and Complex Types (con't)

5.7.2 MORA Signal Resource Profile Complex Types

The following is a list of "MORA Signal Resource Profile Complex Types" used by this specification. Implementations shall be in accordance with the following sections.

Due to the data type interdependency between XML and binary based messaging, it is important that XML values which need to be translated to a binary format (e.g., on the ML2B) conforms with the precision outlined in this specification. The XML schema data formats do not provide the binary precision constraints that are specified.

The XML schema data format of "integer" shall be 32-bit signed integers, while "unsigned integer" shall be 32-bit unsigned integers. The XML schema data format of "real number" shall be 32-bit floating point numbers. There are instances where some XML schema data formats require a larger range; these formats shall be specified as "integer (64-bit)" (long) or "real number (64-bit)" (double) where necessary.

The terms "restricted string" and "restricted URI" are described in VICTORY sections titled "String Bounds" and "URI Bounds" under "VICTORY Data Types." String enumerations further restrict the String Bounds to the predefined list of values.



MORA SIGNAL RESOURCE PROFILE (MSRP)



– MORA Signal Resource Profile (MSRP) Complex Types Summary

MORA Signal Resource Profile

- MORA Device
- MORA Configurations
- Waveforms
- Waveform Operations
- Reference Connections
- Static Internal Connections
- Static External Connections
- Signal Ports
- Antenna Arrays
- Manifold Bands
- Switch Groups
- Configuration Parameters



ATLAS MSRP LEGEND



“Within the specification data type definitions, data formats primarily include restricted string, restricted URI, integer (32-bit), unsigned integer (32-bit), long (64-bit integer), float (32-bit real), double (64-bit real), and Boolean.

The ATLAS template includes valid data value ranges in (), data value units in [] and other description information or notes in { }.

Legend:

"Complex Type Name" or List		Inclusive list bounds <lower limit:upper limit> Where upper limit of "N" is unbounded or inherently bounded {Description/Notes}
Attribute Name	Value from Profile	Data Format (Data Range) [Units] MDM Type1 VRT Control/Context Field {Description/Notes}
Attribute Name	Implementation Specific or Value from Profile	Data Format (Data Range) [Units] MDM Type1 VRT Control/Context Field {Description/Notes}

[R] if required, [RC] if required conditionally, otherwise optional

Data Format Note: All "integer" values shall be 32-bit signed integers, while "unsigned integer" values shall be 32-bit unsigned integers. All "real number" values shall be 32-bit floating point numbers. There are instances where some values require a larger range; these values shall be specified as "long" for 64-bit integers or "double" for 64-bit floating point numbers where necessary.

The purpose of this MSRP XML Structure tab is to standardize the organization and binding of profile information (resource attributes and configuration parameters) for a given MORA device (MORA Device, MORA Signal Resource Manager, and MORA Signal Port Manager component types) implementation in a given physical location in a given system (program specific). This profile is not intended to change across a production series. This profile does not include information that will change from one hardware instance to the next hardware instance such as a serial number ("Equipment ID").

The ATLAS template includes [R] indicators for "required" simple and complex types and indicates inclusive lower and upper bounds within <> symbols for the length of lists.

The MSRP feeds values from the device profile for return values of the request / response interactions of the MD and MSRM SW Component Types. There are instances where there are correlations to the MSPM Component Type and MDM Type 1 VRT control and context fields indicated within | | symbols.



MSRP IN ATLAS



- MORA Signal Resource Profile
 - MORA Device
 - MORA Configurations
 - Waveforms
 - Waveform Operations

MORA Signal Resource Profile <49019-20221221, Pro>
MORA Signal Resource Profile Complex Types
MoraSignalResourceProfileComplexTypes.xsd

"MORA Signal Resource Profile" [R]				
MORA Device [R]				
	"MORA Device"			
	ID [R]	Value from Profile	Integer (1 to 63) Stream ID	
	Type [R]	Value from Profile	Restricted String (OTH, RHD, RCD, SDR) Stream ID	
	Sub Type [R]	Value from Profile	Restricted String (RXO, TXO, TOR, TAR)	
	Service Name [R]	Value from Profile	Restricted String (Corresponds to VICTORY service name)	
	Version Info URL	Implementation Specific or Value from Profile	Restricted URI (Implementation specific for dynamic DHCP IP assignments and value from profile for static IP assignments)	
MORA Configurations [R]				
	List "MORA Configuration"		<1:N>	
	ID [R]	Value from Profile	Integer (>0)	
	Name [R]	Value from Profile	Restricted String	
	Configuration Files	List "File Name" corresponding to "MORA File"	<1:N> (Type="CONFIGURATION")	
		File Name [R]	Value from Profile	Restricted String
	Supported Signal Ports [RC]	List "ID" corresponding to "Signal Port"	<1:127> (Supported Signal Ports is required when MSRM and MSPM are present)	
		ID [R]	Value from Profile	Integer (1 to 127) Stream ID
	Supported Switch Groups [RC]	List "ID" corresponding to "Switch Group"	<1:127> (Supported Switch Groups is required when MSRM and MSPM are present with at least one Switch Group)	
		ID [R]	Value from Profile	Integer (1 to 127) Stream ID
Waveforms				
	List "Waveform"		<1:N>	
	ID [R]	Value from Profile	Integer (>0)	
	Description [R]	Value from Profile	Restricted String	
	RF Function [R]	Value from Profile	Restricted String (RXO, TXO, TOR, TAR)	
	Frequency Range [R]	"Frequency Range"		RF Reference Frequency {Operating frequency range and resolution of this waveform application}
		Start [R]	Value from Profile	Double (-2^43 to 2^43 - (1/2^20)) [Hz] (fractional resolution is 1/2^20 Hz)
		End [R]	Value from Profile	Double (-2^43 to 2^43 - (1/2^20)) [Hz] (fractional resolution is 1/2^20 Hz, End ≥ Start)
		Resolution [R]	Value from Profile	Double (0 to 2^43 - (1/2^20)) [Hz] (fractional resolution is 1/2^20 Hz)
	Associated Signal Ports [R]	List "ID" corresponding to "Signal Port"	<1:127>	
		ID [R]	Value from Profile	Integer (1 to 127) Stream ID
Waveform Operations				
	List "Waveform Operation"		<1:N>	
	ID [R]	Value from Profile	Integer (>0)	
	MORA Configuration IDs [R]	List "ID" corresponding to "MORA Configuration"	<1:N>	
		ID [R]	Value from Profile	Integer (>0)
	Waveform IDs [R]	List "ID" corresponding to "Waveform"	<1:N>	
		ID [R]	Value from Profile	Integer (>0)



MSRP IN ATLAS (CON'T)



- Reference Connections
- Static Internal Connections
- Static External Connections

Reference Connections	List "Reference Connection"		<1:127>	
	Reference Port ID [R]	Value from Profile	Integer (1 to 127)	
	Signal Port IDs [R]	List of Integers		<1:N>
		Signal Port ID	Value from Profile	Integer (1 to 127)
	Association [R]		Restricted String (CONDUCTED_INJECTION, RADIATED_INJECTION, SELECTABLE_INJECTION, FUNCTIONALLY_DEPENDENT)	
Static Internal Connections	List "Connection"		<1:N>	
	Port ID 1 [R]	Value from Profile	Integer (1 to 127) {Shall be less than Port ID 2}	
	Port ID 2 [R]	Value from Profile	Integer (1 to 127)	
	Gain Delta [R]	Value from Profile	Float [dB]	
	Delay Delta [R]	Value from Profile	Long [femtoseconds]	
Static External Connections	List "External Connection"		<1:N>	
	Local Signal Port ID [R]	Value from Profile	Integer (1 to 127)	
	External Signal Port ID [R]	Value from Profile	Integer (1 to 127)	
	External Device [R]	Value from Profile	Restricted String (xxxx) {concatenated xxx is "Type" and yy is "ID" with no zero padding that corresponds to the "MORA Device ID"}	
	Gain Delta	Value from Profile	Float [dB]	
	Delay Delta	Value from Profile	Long [femtoseconds]	

- Antenna Arrays
- Manifold Bands

- Configuration Parameters (1 of 2)

- Configuration Parameters (1 of 2)

[illegible]



MSRP IN ATLAS (CON'T)



Configuration Parameters (2 of 2)

Signal Resource [RC]		Signal Resource		(Required when the MORA Signal Resource Manager and MORA Signal Port Manager component types are present.)	
		MORA Signal Resource Manager [R]		MORA Signal Resource Manager Configuration	
		Version Information [R]		Version Information	
		Interface Type [R]		Value from Profile	Restricted String (from 49302 spec tables)
		Interface Standard Version [R]		Value from Profile	Restricted String (from 49302 spec tables)
		Interface SOAP Components [R]		SOAP Component	Choice of: [R]
				SOAP Component Type [R]	Value from Profile
				Ports [R]	Choice of: [R]
				Standard Version [R]	Value from Profile
				Partial URI info	Value from Profile
				Port [R]	Value from Profile
				Path	Restricted String (shall include a forward slash "/" as the first character.)
		Service Instance Name		Value from Profile	Restricted String
		MSRM Service Instance Name [R]		Value from Profile	Restricted String
		MSRM Listen to MSPM [R]		"Socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
				MUI [R]	Value from Profile
		MSRM Talk to MSPM [R]		"Socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
				MUI [R]	Value from Profile
		MSRM to MSPM MDM Types [R]		List of Integers	Value from Profile
				MDM Type [R]	Value from Profile
		MDM NACK Timeout [R]		Value from Profile	Integer (>0) [microseconds] (Time to wait for ACK, until MDM is considered a no-response, if ACK requested)
		Max Number of MDM Retransmissions [R]		Value from Profile	Integer (>0) (Number of times to retransmit an MDM in response to NACK or no-response, if ACK requested)
		MDM Time of Day Transmission Period [R]		Value from Profile	Integer (>0) [milliseconds] (0 if not periodically sent)
		MORA Signal Port Manager [R]		MORA Signal Port Manager Configuration	
		MSPM Listen to MD [R]		"Socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
				MUI [R]	Value from Profile
		MSPM Talk to MD [R]		"Socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
				MUI [R]	Value from Profile
		MSPM Listen to MSRM [R]		"Socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
				MUI [R]	Value from Profile
		MSPM Talk to MSRM [R]		"Socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
				MUI [R]	Value from Profile
		MSPM to MD MDM Types [R]		List of Integers	Value from Profile
				MDM Type [R]	Value from Profile
		MSPM to MSRM MDM Types [R]		List of Integers	Value from Profile
				MDM Type [R]	Value from Profile
		MDM NACK Timeout [R]		Value from Profile	Integer (>0) [microseconds] (Time to wait for ACK, until MDM is considered a no-response, if ACK requested)
		Max Number of MDM Retransmissions [R]		Value from Profile	Integer (>0) (Number of times to retransmit an MDM in response to NACK or no-response, if ACK requested)
		MDM Health Transmission Period [R]		Value from Profile	Integer (>0) [milliseconds] (0 if not periodically sent)
		Operations Interface Intermediate Appliance [RC]		Intermediate Appliance Configuration	
		Intermediate MD Talk to MSPM [R]		"Intermediate socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
		Intermediate MD Listen to MSPM [R]		"Intermediate socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
		Intermediate MSRM Talk to MSPM [R]		"Intermediate socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
		Intermediate MSRM Listen to MSPM [R]		"Intermediate socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
		Intermediate MSPM Listen to MD [R]		"Intermediate socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
		Intermediate MSPM Talk to MD [R]		"Intermediate socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
		Intermediate MSPM Listen to MSRM [R]		"Intermediate socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile
		Intermediate MSPM Talk to MSRM [R]		"Intermediate socket"	
				MAC [R]	Value from Profile
				IP [R]	Value from Profile
				Port [R]	Value from Profile



Part 6: Summary for the MORA Implementation of VITA 49.2



MORA Implementation Limitations of VITA 49.2 Standard



MORA LIMITATIONS ON V49.2



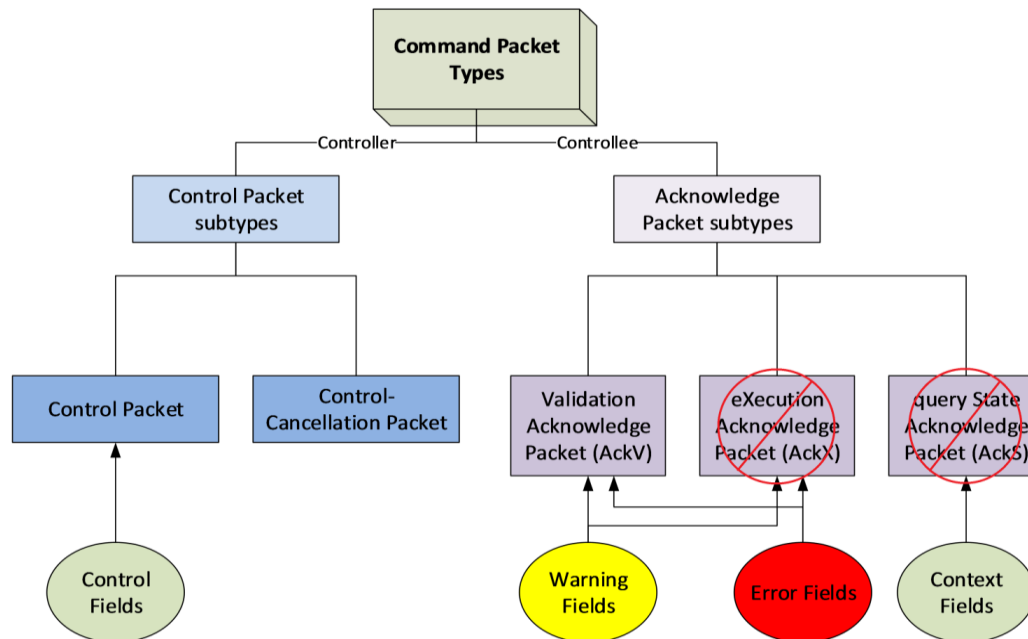
- **Limits Packet Types Supported (3 of 8 types allowed)**
 - Signal Data with Stream ID (Packet Type 0001)
 - Context (Packet Type 0100)
 - Command (Packet Type 0110)
- **Limits Timestamp Format (1 of 3 formats allowed)**
 - When present, Timestamp Integer (TSI) Format is real time UTC seconds only and Timestamp Fractional (TSF) Format is real time UTC picoseconds only
- **Limits Signal Data Item Format (5 of 19 formats allowed)**
 - Includes same four data item formats as V49.a
 - Real and Complex Cartesian (Complex Polar not supported)



MORA LIMITATIONS ON V49.2



- **Limits Command Packet Acknowledge Packet Subtypes (1 of 3 acknowledge subtypes allowed)**
 - Supports Validation Acknowledge (AckV) Only (No AckX or AckS responses)
 - AckX unnecessary (added context packet occurrence regulation)
 - ReqS allowed – but it results in a full context packet response





MORA LIMITATIONS ON V49.2



- **Limits Control / Context Fields (33 of 115 fields allowed)**
 - Many V49.2 field functions apply to the processing layer and other functions (i.e. PNT) handled by other interfaces on VDB
 - All MORA used control / context fields shown in green below are within CIF0 and CIF1 (simplifies parsing)

VITA 49.2 Context/Command Indicator Field (CIF) Matrix and Bit Assignments

Bit	CIF 0 (VITA 49.2)	CIF 1 (VITA 49.2)	CIF 2 (VITA 49.2)	CIF 3 (VITA 49.2)	CIF 7 (VITA 49.2)
	Legacy Fields, CIF enables	Spatial, Signal, Spectral, I/O, Ctl	Identifiers (tags)	Temporal, Environmental	Attributes
31	Context Field Change Indicator	Phase	Bind	Timestamp Details	Current Value
30	Reference Point Identifier	Polarization	Cited SID	Timestamp Skew	Average Value
29	Bandwidth	3-D Pointing Vector	Sibling(s) SID	Reserved	Median Value
28	IF Reference Frequency	3-D Pointing Vector Structure	Parent(s) SID	Reserved	Standard Deviation
27	RF Reference Frequency	Spatial Scan Type	Child(ren) SID	Rise Time	Max Value
26	RF Reference Frequency Offset	Spatial Reference Type	Cited Message ID	Fall Time	Min Value
25	IF Band Offset	Beamwidth	Controllee ID	Offset Time	Precision
24	Reference Level	Range (Distance)	Controllee UUID	Pulse Width	Accuracy
23	Gain	Reserved	Controller ID	Period	1 st Derivative (Velocity)
22	Over-range Count	Reserved	Controller UUID	Duration	2 nd Derivative (Acceleration)
21	Sample Rate	Reserved	Information Source	Dwell	3 rd Derivative
20	Timestamp Adjustment	Eb/No BER	Track ID	Jitter	Probability
19	Timestamp Calibration Time	Threshold	Country Code	Reserved	Belief
18	Temperature	Compression Point	Operator	Reserved	Reserved
17	Device Identifier	2 nd and Third-Order Intercept Points	Platform Class	Age	Reserved
16	State/Event Indicators	SNR/Noise Figure	Platform Instance	Shelf Life	Reserved

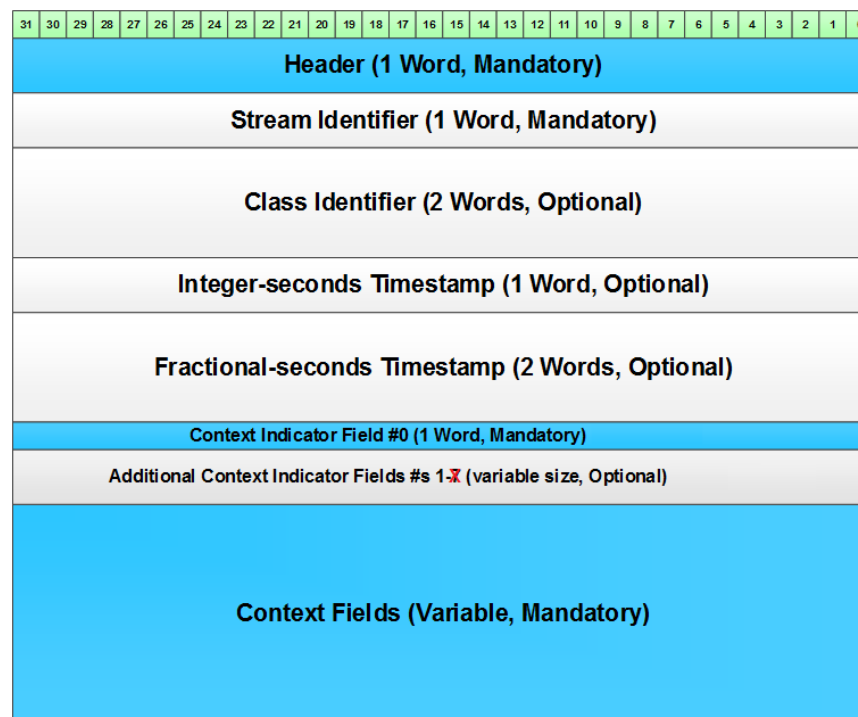
Bit	CIF 0 (VITA 49.0)	CIF 1 (VITA 49.2)	CIF 2 (VITA 49.2)	CIF 3 (VITA 49.2)	CIF 7 (VITA 49.2)
	Legacy Fields, CIF enables	Spatial, Signal, Spectral, I/O, Ctl	Identifiers (tags)	Temporal, Environmental	Attributes
15	Signal Data Packet Payload Format	Aux Frequency	Platform Display	Reserved	Reserved
14	Formatted GPS	Aux Gain	EMS Device Class	Reserved	Reserved
13	Formatted INS	Aux Bandwidth	EMS Device Type	Reserved	Reserved
12	ECEF Ephemeris	Reserved	EMS Device Instance	Reserved	Reserved
11	Relative Ephemeris	Array of CIFS	Modulation Class	Reserved	Reserved
10	Ephemeris Ref ID	Spectrum	Modulation Type	Reserved	Reserved
9	GPS ASCII	Sector Scan/Step	Function ID	Reserved	Reserved
8	Context Association Lists	Reserved	Mode ID	Reserved	Reserved
7	Field Attributes Enable	Index List	Event ID	Air Temperature	Reserved
6	Reserved for CIF expansion	Discrete I/O (32-bit)	Function Priority ID	Sea/Ground Temperature	Reserved
5	Reserved for CIF expansion	Discrete I/O (64-bit)	Communication Priority ID	Humidity	Reserved
4	Reserved for CIF expansion	Health Status	RF Footprint	Barometric Pressure	Reserved
3	CIF 3 Enable	V49 Spec Compliance	RF Footprint Range	Sea and Swell State	Reserved
2	CIF 2 Enable	Version and Build Code	Reserved	Tropospheric State	Reserved
1	CIF 1 Enable	Buffer Status	Reserved	Network ID	Reserved
0	Reserved	Reserved	Reserved	Reserved	Reserved



MORA LIMITATIONS ON V49.2



- Limits use of context fields to CIF 0 and CIF 1 in Context packets

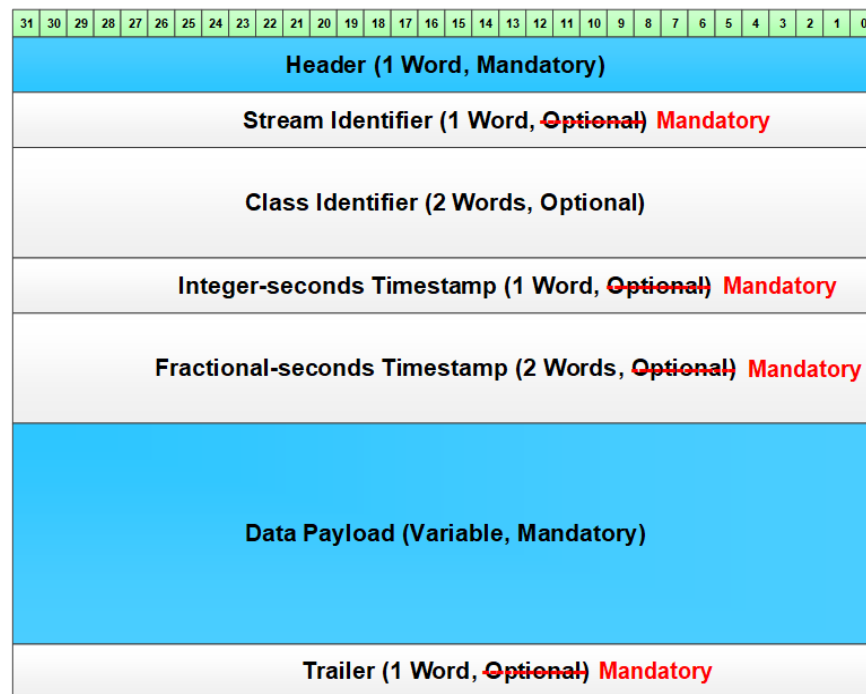




MORA LIMITATIONS ON V49.2



- Requires Steam Identifier, Timestamp and Trailer Use for Signal Data Packets





MORA Implementation Definitions of VITA 49.2 Standard



MORA DEFINITIONS TO V49.2



▪ Defines Stream ID Field (32 bit undefined field)

32-bits																															
16-bits																16-bits															
8-bits								8-bits								8-bits								8-bits							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TYPE			DEVICE ID						PORT ID								SUBPORT ID														

▪ Defines Reference Point ID Field (32 bit undefined field)

32-bits																															
16-bits																16-bits															
8-bits								8-bits								8-bits								8-bits							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MANIFOLD BAND ID											ARRAY ID					ELEMENT ID															

▪ Defines Subfields for Class ID Field

- Pad Bit Count use (pad bit count $\geq$ item packing field size)
- Information Class (“M”ORA plus Major / Minor Version)
- Packet Class (MORA 3 Packet Types)



MORA DEFINITIONS TO V49.2



- **Defines Discrete IO 32 Bit Field (undefined field)**
 - RF Modes (Transmit / Receive / Blank)
 - Triggers
 - Test Source (Delivery Method and Waveform)
 - Coherency Modes
 - Reference Source
 - Gain Control Mode

32-bits																																
16-bits																16-bits																
8-bits								8-bits								8-bits								8-bits								
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
DFIB1						Reserved								GC		REF			CO		TEST SOURCE								TG		RF	
R	T	T	C	R	GC									1	2	1	2	3	L	P	WAVEFORM				DM				1	2	T	R
F	G	S	O	F																												



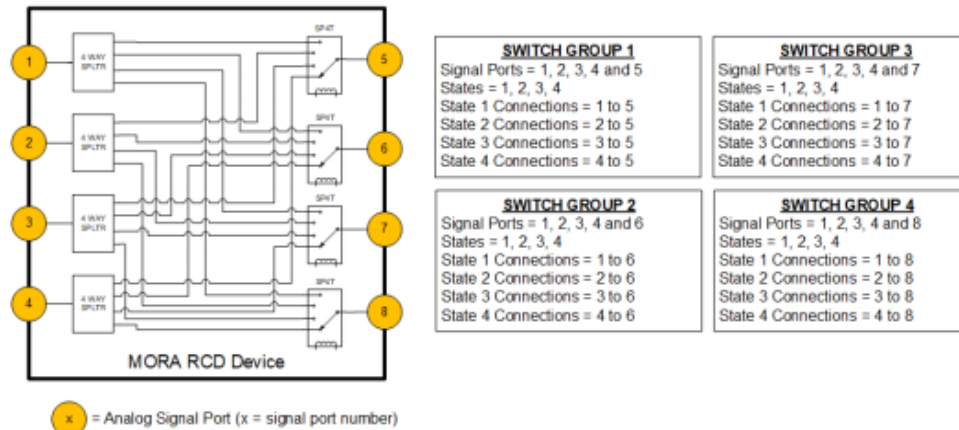
MORA DEFINITIONS TO V49.2



- **Defines Discrete IO 64 Bit Field (undefined field)**
 - Filter Bank #1 / #2 / #3 Selection
 - Switch Group / State

32-bits																																	
16-bits																16-bits																	
8-bits								8-bits								8-bits								8-bits									
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
DFIB2			Reserved 1													FILTER 3				FILTER 2				FILTER 1									
F1	F2	F3																															
DFIB3			Reserved 2										SWITCH CONTROL/STATUS																				
SW	r	r											GROUP ID				STATE ID																

RF Source Selection Application



MORA Mapping of Switch Groups and States Example



MORA Implementation Additions to VITA 49.2 Standard



MORA ADDITIONS TO V49.2



■ Added “Test Source ON” markers

Table 63 Trailer Enable and Indicator Bits

■ Trailer Field

Enable Bit Position	Indicator Bit Position	Indicator Name
31	19	Calibrated Time Indicator
30	18	Valid Data Indicator
29	17	Reference Lock Indicator
28	16	AGC/MGC Indicator
27	15	Detected Signal Indicator
26	14	Spectral Inversion Indicator
25	13	Over-range Indicator
24	12	Sample Loss Indicator
23,22	11,10	Sample Frame Indicators, User-Defined
21	9	User-Defined Indicator
20	8	Test Source <u>On</u> Indicator



Table 46 State/Event Indicator Field Enable and Indicator Bits

■ State and Event Field

Enable Bit Position	Indicator Bit Position	Indicator Name	Period of Validity
31	19	Calibrated Time Indicator	Persistent
30	18	Valid Data Indicator	Persistent
29	17	Reference Lock Indicator	Persistent
28	16	AGC/MGC Indicator	Persistent
27	15	Detected Signal Indicator	Persistent
26	14	Spectral Inversion Indicator	Persistent
25	13	Over-range Indicator	Single Data Packet
24	12	Sample Loss Indicator	Single Data Packet
[23, 22, 21]	[11, 10, 9]	Reserved	N/A
20	8	Test Source <u>On</u> Indicator	Persistent
[7...0]	[7...0]	Reserved	N/A





MORA ADDITIONS TO V49.2



■ Context packet generation rules:

- Added MORA rule based on a modified version of rule 7.1.5-1 from V49.0

“With the exception of the Over-Range Count Field (CIF 0/Bit 22), all MORA context fields shall be interpreted to be persistent. That is, the metadata contained in a Context field shall be understood to be persistent between Context updates. Therefore, a new context packet shall be sent when fields previously reported have experienced a value change beyond the device’s measurement error or repeatability tolerances. Regulations to this effect that appeared in V49.0 (Rule 7.1.5-1) have been omitted in V49.2 with only the spirit contained within normative text in Section 7.1.4. For MORA, the V49.0 rule shall apply and is shown below with strikethrough edits for V49.2 consistency.”

“V49.0 Rule 7.1.5-1: When the Context Packet Stream includes a ‘Persistent’ Context field, the emitter shall emit ~~an IF~~ Context Packet when the underlying metadata changes. The emitter may emit that Context field more often if desired.”

- MORA requires periodic (at least once a second) full context packets be generated to support non-controlling users who subscribe to a multicast group when the session is already in progress.



MORA Session Two Complete



MORA TRAINING SYLLABUS



Session One: Introduction to MORA (DIST A): (2 Hours)

- Part 1: Introduction to MORA (Motivation, Objectives, Foundation, Core Features, History/Future)
- Part 2: MORA Formal Definitions (Devices, Resources, Ports)
- Part 3: MORA Client Control Structure (Device Level, Processing Resource and Signal Resource)

Session Two: Signal Resource Overview (DIST A): (2 Hours)

- Part 4: Signal Resource Component Types (Key Interactions)
- Part 5: MORA Signal Resource Profile (MSRP) (Electronic RF Datasheet)
- Part 6: Summary for the MORA Implementation of VITA 49.2 (limitations, clarifications, additions)

Session Three: Signal Resource Interactions and Networks (DIST A): (4 Hours)

- Part 7: VDB Management Interactions (MORA Device, MORA Signal Resource Manager)
- Part 8: ML2B RF Layer Data, Context and Command Interactions (MDM Type 1)
- Part 9: Operations interactions (MDM Types 2-7)
- Part 10: Network Environments (VDB and ML2B)

Session Four: (DIST C): (2 Hours)

- Part 11: (DIST C)
- Part 12: (DIST C)
- Part 13: (DIST C)

Session Five: (DIST C): (2 Hours)

- Part 14: MORA Processing Resources (DIST A)
- Part 15: (DIST C)
- Part 16: (DIST C)



Wrap-Up Discussions