UNCLASSIFIED

Interface Design Description

Between the ELM-2135 Radar

and

C2

Prepared by
Elta Systems Ltd.

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1. SCOPE

1.1 Identification

This Interface Design Description (IDD) establishes the interface definition between the Command and Control (C2) and the Radar Computer (RC). The following interfaces are defined in this document.

<u>Interface Name</u>	<u>Description</u>
C2-RC	Supports the interface between the C2 and the RC.
RC-C2	Supports the interface between the RC and the C2.

1.2 System Overview

The ELM-2135 is an all-weather modular Multi Mission RADAR System, the system designed to perform air situation awareness missions to tactical platforms. The TDP application use for Interface management and provide the ELM-2135 ICD over TCP\UDP via Ethernet communication.
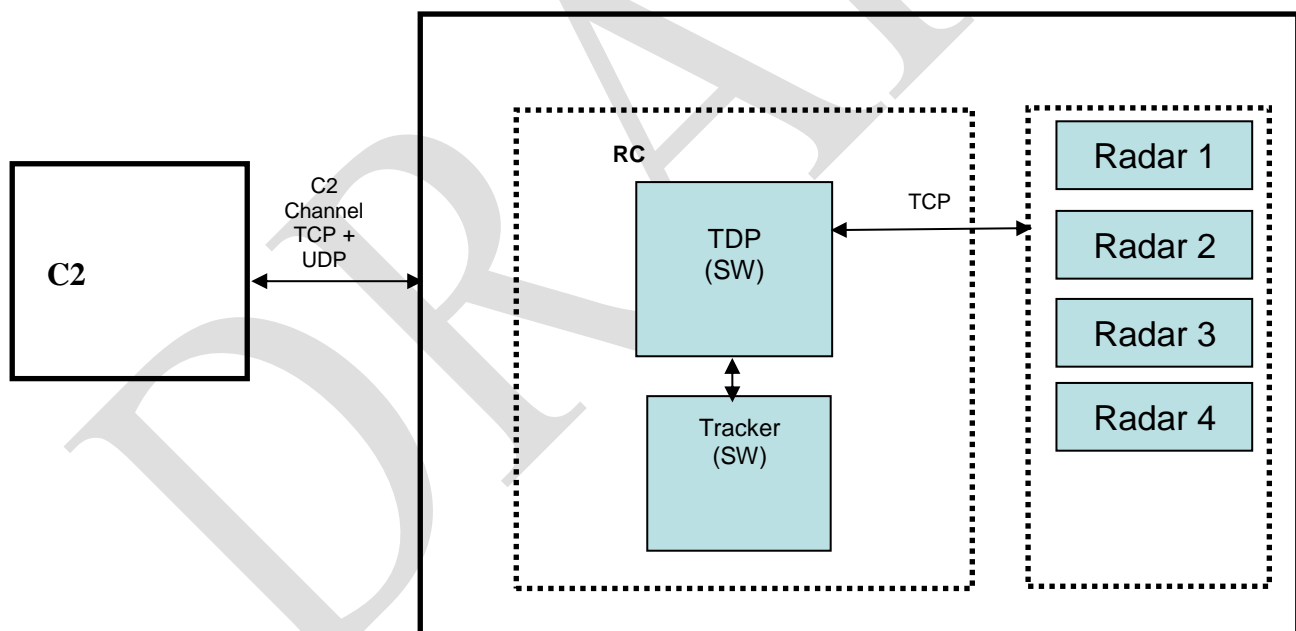
Figure 1: ELM2135 Radar HW and SW Configuration

1.3   Document Overview

This document specifies the interfaces between the ELM-2135 Radar system and External system. This document has been written in accordance with MIL-STD-498 Interface Design Description (IDD) (Ref. Doc. [MS-IDD]).

The contents of this document are as follows:

Section 1	Defines the scope, identifies the interface, and provides both a system and document overview.
Section 2	Lists all Referenced Documents in this IDD.
Section 3	Is divided into paragraphs that describe the interface characteristics.
Section 4	Contains two traceability tables to/from each interfacing entity covered by this IDD to the system or CSCI requirements addressed by the entity's interface design.
Section 5	Contains an alphabetical listing of all acronyms, abbreviations, and their meanings as used in this document and a list of terms and definitions needed to understand this document.

2. REFERENCED DOCUMENTS

This section presents only those documents referenced in this document.

Documents in the following table maybe referenced throughout this document using the notation Ref. Doc. [Ref Id]. The applicable revision and date of the documents are of the last edition published as of the date of this document, unless otherwise stated.

2.1   Government Documents

2.1.1   Specifications, Standards and handbooks

Ref. Id	Identification (P/N)	Title
[GD-1]	AMSC No. N7069	MIL-STD-498 Software Development and Documentation
[MS-IDD]	DID DI-IPSC-81436	MIL-STD-498 DATA ITEM DESCRIPTION for Interface Design Description (IDD)

Table 1: Project Reference Documents

2.1.2   Other Government Documents, Drawings and Publications

None

2.2   Non-Government Documents

None

3. Interface Design

3.1 Interface Identification and Diagrams

The following diagram depicts the interface between the different components.
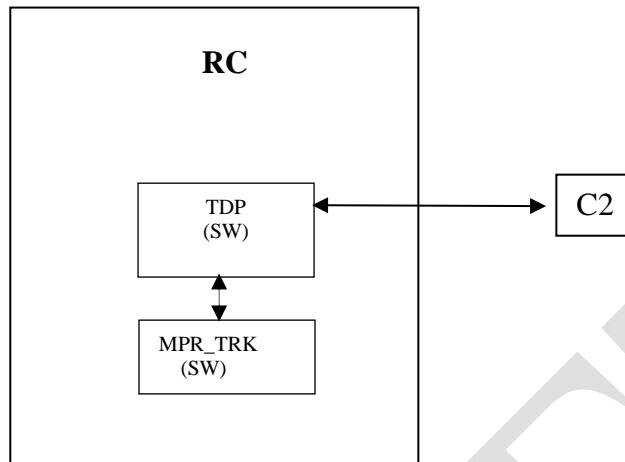
Figure 2: Interface Diagram

Interface ID	CSCI	Interface Type
C2-RC	TDP	Ethernet (TCP+UDP)
RC-C2	TDP	Ethernet (TCP+UDP)

Table 2: Interface Identification

TCP client/server.
RC – TCP Server The port is configurable .
C2 – TCP Client .

UDP
The Send port from RC is configurable.
The Recive port at RC is configurable.

RC IP Address is configurable
The TCP channel type can be configured as TCP / UDP. The type in this document is only recommended.

3.1.1 Endianness

The byte order of this ICD is **little-endian.**

3.2 Interface Message Header Structure

The Message Header structure is indetical for C2-RC and RC-C2 interfaces

SIGNAL NAME	SIZE (Bytes)	DESCRIPTION
Message Id	4	Message ID - code
Message Length	4	Message Length include header + body in bytes
Message Time Tag	4	Message time Tag (MS from midnight)
Message Sequence Number	4	Message Sequence Number
Message source_id	4	

Table 3: Message Header

3.3 C2-RC Interface

The purpose of the C2 – RC is to support the interface between the C2 Unit and the RC Unit. Using this channel the C2 send the defined messages at message descriptions.
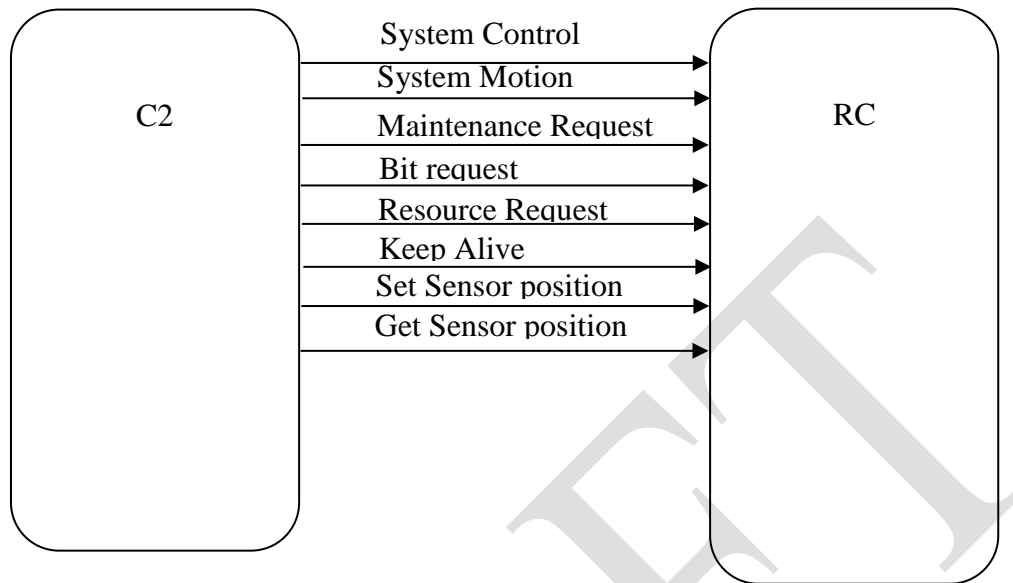
Figure 3: C2_RC Message Blocks

3.3.1 Interface Priority

Priorities for this interface are as follows:

- Interface Priority: High

3.3.2 Interface Type

The type of interface is TCP client/server and UDP.

3.3.3 Data Elements

Refer to the peregraph 6 .

3.3.4 Data Element Assemblies

3.3.4.1 Block Alignment

Each message is formatted in a protocol.
Message is composed of:
- Header
- Body

3.3.5 Message Descriptions

Messages that are transferred from the C2 to the RC via the C2_RC message block are as follows:

Source	Target	Message ID	Message Name	Protocol
C2	RC	0xCEF00401	System Control	TCP
C2	RC	0xCEF00412	System Motion	TCP
C2	RC	0xCEF0040C	Maintenance Request	TCP
C2	RC	0xCEF0040A	Bit request	TCP
C2	RC	0xCEF0040D	Resource Request	TCP
C2	RC	0xCEF00400	Keep Alive	UDP
C2	RC	0xCEF00418	set Sensor position	TCP
C2	RC	0xCEF00419	get sensor position	TCP

Table 4: C2_RC Messages

3.3.6 Communication Methods (Physical Layer)

3.3.6.1 Interconnections

Ethernet

3.3.6.2 Other Characteristics

N/A

3.4 RC-C2 Interface

The purpose of the RC – C2 is to support the interface between the RC Unit and the C2 Unit. Using this channel the RC send the defined messages at message descriptions.
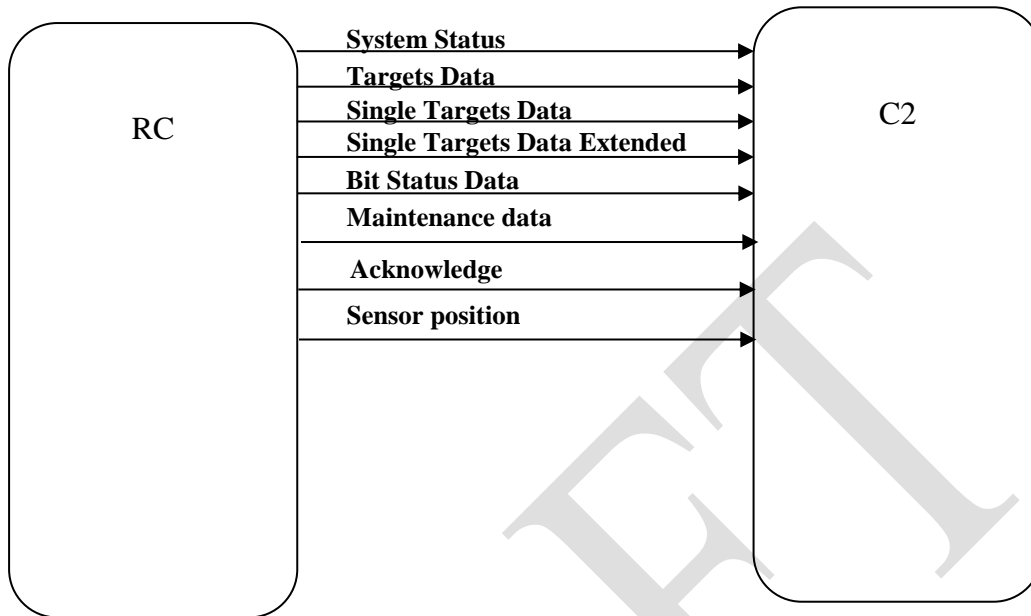
Figure 4: RC_C2 Message Blocks

3.4.1 Interface Priority

Priorities for this interface are as follows:

- Interface Priority: High

3.4.2 Interface Type

The type of interface is TCP client/server and UDP.

3.4.3 Data Elements

Refer to the peregraph 6 .

3.4.4 Data Element Assemblies

3.4.4.1 Block Alignment

Each message is formatted in a protocol.
Message is composed of:

- Header
- Body

3.4.5 Message Descriptions

Messages that are transferred from the RC to the C2 via the RC_C2 message block are as follows:

Source	Target	Message ID	Message Name	Protocol
RC	C2	0xCEF00402	System Status	UDP
RC	C2	0xCEF00403	Target Report	TCP
RC	C2	0xCEF00404	Single Target Report	TCP
RC	C2	0xCEF00414	Single Targets Data extended	TCP
RC	C2	0xCEF00406	Bit Status Data	UDP
RC	C2	0xCEF00407	Maintenance data	TCP
RC	C2	0xCEF00405	Acknowledge	TCP
RC	C2	0xCEF0041A	Sensor position	TCP

Table 5: RC_C2 Messages

3.4.6 Communication Methods (Physical Layer)

3.4.6.1 Interconnections

Ethernet

3.4.6.2 Other Characteristics

N/A

3.4.7 Data Types

Abbrev.	Size	Description
UL	32 bits	Unsigned Long
L	32 bits	Long
US	16 bits	Unsigned Short
S	16 bits	Short
D	64 bits	Double
F	32 bits	Float
C	8 bits	Char
UC	8 bits	Char
I_64	64 bits	Int64
ENUM	32 bits	Enum
B	8	Bool

4. Notes

4.1 List of Acronyms

The following table defines the Acronyms and Abbreviations used in this document.

Acronym/Abbreviation	Description
AS	Air Surveillance
BIT	Built in Test
C2	Command & Control
CSCI	Computer Software Configuration Item
CU	Control Unit
EXTAPP	External Application (i.e. C2)
GDU	General Display Unit
HMI	Human Machine Interface
HPT	High Priority Target
H/W	Hardware
INS	Inertial System
IO	Input/output
LRU	Line Replaceable Unit
MFL	Malfunction List
MMI	Man, Machine Interface
PC	Personal Computer
RC	Radar Computer
RDP	Radar Data Processor
RSP	Radar Signal Processor
SMC	Sub Mode Change
SNR	Signal Noise Ratio
SSDD	System/Subsystem Design Description
SSS	System/Subsystem Specification
SRS	Software Requirements Specification
TWS	Track While Scan (Tracker)
MRS	Module Radar System
FR	Front Right Antenna – Anttenna 1
BR	Back Right Antenna – Anttenna 2
BL	Back Left Antenna – Anttenna 3
FL	Front Left Antenna – Anttenna 4

Acronym/Abbreviation	Description
HFL	Hostile Fire Locator

5. Message Data Definition

This defines the data definition for each message described in section 3 of this document.

5.1 C2 to RC Messages

5.1.1 System Control

Message Name   : System Control
Message Code/Id   : 0xCEF00401
Message Size   : 60 Bytes
In/Out Type   : In
Rate   : Upon request
Timing Constraints   :
Acknowledge Required   :
Validation   : None
Message Ability   :
Description   : This message sends control command to the RC
Message Words   : See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	RDR_STATE	4	ENUM	2 – STANDBY 3 – MAINTENANCE 4 – OPERATE	
3.	Mission Category	4	ENUM	UP TO 5 MISSION	0-4
4.	HFL_Sensor1_control	1	UC		0-Enable 1-Disable
5.	HFL_Sensor2_control	1	UC		0-Enable 1-Disable
6.	HFL_Sensor3_control	1	UC		0-Enable 1-Disable
7.	HFL_Sensor4_control	1	UC		0-Enable 1-Disable
8.	Radar1_control	1	UC	Not relevant	0-Enable 1-Disable
9.	Radar2_control	1	UC	Not relevant	0-Enable 1-Disable
10.	Radar3_control	1	UC	Not relevant	0-Enable 1-Disable
11.	Radar4_control	1	UC	Not relevant	0-Enable 1-Disable
12.	Freq Index	4	UL		1-10
13.	Spare[0:4]	4*5	UL		

- The missions Category and paramtesrs will be supply outside of this ICD depeding on the configuration of the system .

5.1.2　**System Motion**

Message Name	:	System Motion
Message Code/Id	:	0xCEF00412
Message Size	:	192 Bytes
In/Out Type	:	In
Rate	:	50 [Hz]
Timing Constraints	:	
Acknowledge	:	
Required		
Validation	:	None
Message Ability	:	
Description	:	The system Motion message including location and inertial data including velocities and acceleration of the system. The C2 system need to provide the message data in recommended rate of at least 50 [Hz] from the platform including all describe data. In case that the system is static the Motion message should send ones after powerup.

The data is relative to a point in the platform. Zero point on DP plane:

Reference Plane	Symbol	Planes
Datum Plane	DP	XY
Longitudinal Plane	LP	XZ
Traverse Plane	TP	YZ

The "LOCATION" represents the platform place with respect to GEO coordinates.

The "TILTING ANGLES" represent the platform inclination with respect to the LGC coordinates. The "TILTING ANGLES" is the rotation of the Platform coordinate system around each of its axes, Px, Py, Pz. (NED system)

Rotation clockwise when looking outwards

- Around Px axis→ +Proll.

- Around Py axis→ +Ppitch.

- Around Pz axis→ +Pyaw.
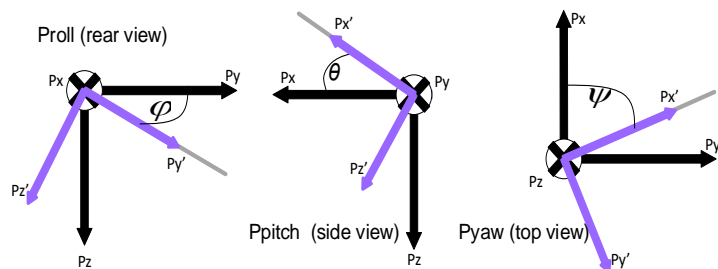
The positive direction of the platforms axes, when looking from DP outwards is:

- Px→ forward.

- Py→ right.

- Pz→ down.
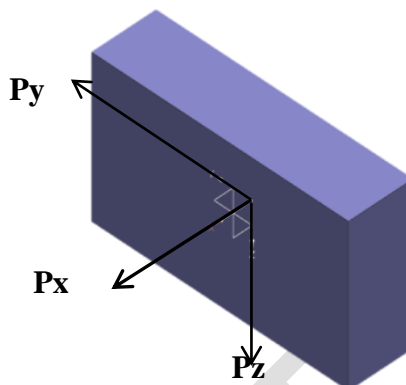
Message Words   :   See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	timeOfDataGeneration	8	I_64	milliseconds	milliseconds
3.	currentPosition_altitude	8	D	altitude	meters
4.	currentPosition_latitude	8	D	latitude	Radians [-pi/2 : pi/2]
5.	currentPosition_longitude	8	D	longitude	Radians [-pi : pi]
6.	sensorAttitude_pitch	8	D	pitch	Radians [-pi/2 : pi/2]
7.	sensorAttitude_roll	8	D	roll	Radians [-pi/2 : pi/2]
8.	sensorAttitude_yaw	8	D	yaw	Radians [-pi : pi]
9.	PlatformHeading	8	D	Current platform heading	
10.	Spare1	8	D	spare	
11.	Spare2	8	D	spare	
12.	Spare3	8	D	spare	
13.	northVelocity	8	D	North velocity Speed	m/sec
14.	eastVelocity	8	D	East velocity Speed	m/sec
15.	downVelocity	8	D	Down velocity Speed	m/sec
16.	angularVelocity_X	8	D	Angular velocity forward	Rad/sec
17.	angularVelocity_Y	8	D	Angular velocity right	Rad/sec
18.	angularVelocity_Z	8	D	Angular velocity down	Rad/sec
19.	Acceleration_X	8	D	Linear platform frame acceleration forward. X component (x axis)	m/sec².
20.	Acceleration_Y	8	D	Linear platform frame acceleration right. Y component (x axis)	m/sec².
21.	Acceleration_Z	8	D	Linear platform frame acceleration right. Z component (x axis)	m/sec².
22.	Spare[0:2]	3*4	UL	spare	

5.1.3 Maintenance Request

Message Name   :   Maintenance Request

Message Code/Id   :   0xCEF0040C

Message Size   :   20 Bytes

In/Out Type   :   In

Rate   :   Upon user request

Timing Constraints   :

Acknowledge Required   :

Validation   :   None

Message Ability   :

Description   :   The message is a request for system maintenance and version data. The system replies with maintenance data message. **The message applicable on maintenance and standby state**

Message Words   :   See table below

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	

5.1.4   BIT Request

Message Name   :   BIT Request
Message Code/Id   :   0xCEF0040A
Message Size   :   20 Bytes
In/Out Type   :   In
Rate   :   Upon user request
Timing Constraints   :
Acknowledge Required   :
Validation   :   None
Message Ability   :
Description   :   The message is a request for system-initiated Build in Test
                            (IBIT) , the system will respond with BIT Status Data Message.
                            The message is applicable only in maintenance state
Message Words   :   See table below

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	

5.1.5   Resource Request

Message Name   : Resource Request
Message Code/Id   : 0xCEF0040D
Message Size   : 96 Bytes
In/Out Type   : In
Rate   : Upon user request
Timing Constraints   :
Acknowledge Required   :
Validation   : None
Message Ability   :
Description   : The message allows to C2 to request resources from the radar
                           system to increasing tracking rate on chosen Target.
                           the system replies to the request with Acknowledge message.
Message Words   : See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	requestTime	8	I_64	milliseconds	milliseconds
3.	targetID	4	UL	Target ID	
4.	requestType	4	UL	Request typ	3-INIT_HPT 4-INIT_STT 5-DELETE_STT 6-DELETE_HPT 7-DELETE TARGET 8-DELETE ALL_TARGETS
5.	requestPriority	4	UL	Request Priority	0-NORMAL PRIORITY
6.	Spare1	4	UL	spare	
7.	direction_el	8	D	Request target Elevation	[Rad] [-pi/2 : pi/2]
8.	direction_az	8	D	Request target Azimuth	[Rad] [-pi : pi]
9.	direction_range	8	D	Request target Range	meter
10.	velocity	8	D	Request target velocity	meter/sec
11.	Spare2	4	UL	spare	
12.	Spare3	4	UL	spare	
13.	Spare4	4	UL	spare	
14.	Spare5	4	UL	spare	
15.	Spare6	4	UL	spare	

Note: Fields 5 – 15 are for future use

5.1.6 Keep Alive

Message Name   :   keep alive
Message Code/Id   :   0xCEF00400
Message Size   :   20 Bytes
In/Out Type   :   In
Rate   :   Periodic every 1 Sec
Timing Constraints   :
Acknowledge Required   :
Validation   :   None
Message Ability   :
Description   :   message for keep alive UDP channel C2 required to send every 1 second.
Message Words   :   See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	

5.1.7   Set Sensor Position

Message Name   : Set Sensor Position
Message Code/Id   : 0xCEF00418
Message Size   : 92 Bytes
In/Out Type   : In
Rate   : Upon user request
Timing Constraints   :
Acknowledge Required   :
Validation   : None
Message Ability   :
Description   : The message allows to C2 to setting the installation data for each sensor.
                           The message is applicable on maintenance mode.
Message Words   : See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	Sensor_id	4	UL		RADAR_1 = 0 RADAR_2 = 1 RADAR_3 = 2 RADAR_4 = 3 HFL_1 = 4 HFL_2 = 5 HFL_3 = 6 HFL_4 = 7 GFP_1 = 8 GFP_2 = 9
3.	pitch	8	D	right hand rool	Rad [-pi/2 : pi/2]
4.	roll	8	D	right hand rool	Rad[-pi/2 : pi/2]
5.	yaw	8	D	right hand rool	Rad[-pi : pi]
6.	X	8	D	North (NED)	meter
7.	Y	8	D	East (NED)	meter
8.	Z	8	D	Down (NED)	meter
9.	Spare1	4	UL		
10.	Spare2	4	UL		
11.	Spare3	4	UL		
12.	Spare4	4	UL		
13.	Spare5	4	UL		

5.1.8 Get Sensor Position

Message Name	:	Get Sensor Position	
Message Code/Id	:	0xCEF00419	
Message Size	:	24 Bytes	
In/Out Type	:	In	
Rate	:	Upon user request	
Timing Constraints	:		
Acknowledge Required	:		
Validation	:	None	
Message Ability	:		
Description	:	The message is request from C2 to getting the current installation data for each sensor. The message is applicable on maintenance mode, the system replies with sensor position data.	
Message Words	:	See table below.	

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	Sensor_id	4	UL		RADAR_1 = 0 RADAR_2 = 1 RADAR_3 = 2 RADAR_4 = 3 HFL_1 = 4 HFL_2 = 5 HFL_3 = 6 HFL_4 = 7 GFP_1 = 8 GFP_2 = 9

5.2 RC to C2 Messages

5.2.1 System Status

Message Name   : Status Message
Message Code/Id   : 0xCEF00402
Message Size   : 60 Bytes
In/Out Type   : Out
Rate   : 1 Hz or upon change
Timing Constraints   :
Acknowledge Required :
Validation   : None
Message Ability   :

Description   : The Status message sent periodically and including the radar current status contain all parameter same as the control message, the status message can used for acknowledge for control message. The message applicable in all state.

Message Words   : See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	state	4	ENUM	Radar state report:	0 – OFF 1 – INIT 2 – STANDBY 3 – MAINTENANCE 4 – OPERATE
3.	Mission Category	4	ENUM	UP TO 5 MISSION	0-4
4.	Radar1_status	1	B	Radar 1 status	0-fault 1-normal
5.	Radar2_status	1	B	Radar 2 status	0-fault 1-normal
6.	Radar3_status	1	B	Radar 3 status	0-fault 1-normal
7.	Radar4_status	1	B	Radar 4 status	0-fault 1-normal
8.	Tx	4	ENUM	Radar Tx Enable	0 – OFF 1 – ON
9.	Freq Index	4	UL	Up to 10 Frequency	1-10
10.	HFL1_status	1	B	HFL1 status	0-fault 1-normal
11.	HFL2_status	1	B	HFL2 status	0-fault 1-normal
12.	HFL3_status	1	B	HFL3 status	0-fault 1-normal
13.	HFL2_status	1	B	HFL4 status	0-fault 1-normal
14.	Spare1	4	UL		
15.	Spare2	4	UL		
16.	Spare3	4	UL		
17.	Spare4	4	UL		

Notes:

- In case Radar(No)_status is reporting fault the antenna will not report targets

5.2.2 Target Data

Targets data has three type of messages the output message is depent on the system configuration , only one kind of target data message is send .

This Target Base data struct will be used by diffrent messages.
its inefication as **TargetbaseData**
The **TargetbaseData** size is 332 Bytes

1.	targetId	4	UL	Uniq target id	
2.	targetTimeTag	8	I_64	Last update time of the target	Mili Sec From midnight
3.	targetFirstUpdateTime	8	I_64	Target creation time	Mili Sec From midnight
4.	targetSource	4	ENUM		See Appendix A
5.	fusionTargetSource[0:3]	4*4	UL	N/A	
6.	sourceTrack id[0:3]	4*4	UL	N/A	
7.	Target status	4	ENUM	Target status	1 - New 2 - Update 3 – Delete 4 - Extrapolate
8.	score	4	F	0-Not Relevant	0-10
9.	targetClassification	4	ENUM		See Appendix A
10.	ClassificationConfidence	4	F		0-100
11.	seniority	4	UL	Number of updates	
12.	rcs	4	F	Target estimated RCS	unit: [dbsm]
13.	target_elevation	8	D	Polar Coordinate	[Rad] [-pi/2 : pi/2]
14.	target_azimuth	8	D	Polar Coordinate	[Rad] [-pi : pi]
15.	target_range	8	D	Polar Coordinate	meters
16.	target_abs_vel	4	F		m/s
17.	target_course	4	F		Rad
18.	target_sigma_elevation	8	D	Polar Coordinate	[Rad] [0-2pi]
19.	target_sigma_azimuth	8	D	Polar Coordinate	[Rad] [0-2pi]
20.	target_sigma_range	8	D	Polar Coordinate	meters
21.	Number_of_dimention	4	ENUM		1-Radar_2D 2-Radar_3D 3-Optic_2D 4-Fusion_3D 5-HFL_2D
22.	Coordinate_system	4	ENUM		0-SYSTEM_AXIS 1-WORLD_AXIS
23.	cartesianLocationAvailable	1	B		0-Not available 1- available
24.	cartesianVelocityAvailable	1	B		0-Not available 1- available
25.	polarLocationAvailable	1	B		0-Not available 1- available
26.	polarVelocityAvailable	1	B		0-Not available 1- available
27.	geoLocationAvailable	1	B		0-Not available 1- available
28.	absoluteVelocityAvailable	1	B		0-Not available 1- available
29.	cartesianVarianceAvailable	1	B		0-Not available 1- available
30.	Sapr1	1	B		0

31.	target_altitude	8	D	data valid if geoLocationAvailable =1	Meters
32.	target_latitude	8	D	data valid if geoLocationAvailable =1	Radians [-pi/2 : pi/2]
33.	target_longitude	8	D	data valid if geoLocationAvailable =1	Radians [-pi : pi]
34.	target_X	8	D	Cartesian NED, data valid if cartesianLocationAvailable =1	Meters
35.	target_Y	8	D	Cartesian NED, data valid if cartesianLocationAvailable =1	Meters
36.	target_Z	8	D	Cartesian NED, data valid if cartesianLocationAvailable =1	Meters
37.	target_vel_X	8	D	Cartesian NED, data valid if cartesianVelocityAvailable =1	Meters/Sec
38.	target_vel_Y	8	D	Cartesian NED, data valid if cartesianVelocityAvailable =1	Meters/Sec
39.	target_vel_Z	8	D	Cartesian NED, data valid if cartesianVelocityAvailable =1	Meters/Sec
40.	target_sigma_X	8	D	Cartesian NED, data valid if cartesianVarianceAvailable =1	Meters
41.	target_sigma_Y	8	D	Cartesian NED, data valid if cartesianVarianceAvailable =1	Meters
42.	target_sigma_Z	8	D	Cartesian NED, data valid if cartesianVarianceAvailable =1	Meters
43.	target_sigma_vel_X	8	D	Cartesian NED, data valid if cartesianVarianceAvailable =1	Meters/Sec
44.	target_sigma_vel_Y	8	D	Cartesian NED, data valid if cartesianVarianceAvailable =1	Meters/Sec
45.	target_sigma_vel_Z	8	D	Cartesian NED, data valid if cartesianVarianceAvailable =1	Meters/Sec
46.	target_vel_elevation	8	D	Polar Coordinate, data valid if polarVelocityAvailable =1	Rad/s
47.	target_vel_azimuth	8	D	Polar Coordinate, data valid if polarVelocityAvailable =1	Rad/s
48.	target_vel_range	8	D	Polar Coordinate, data valid if polarVelocityAvailable =1	Meter/Sec
49.	target_variance_vel_elevation	8	D	Polar Coordinate,	Rad/s
50.	target_variance_vel_azimuth	8	D	Polar Coordinate,	Rad/s
51.	target_variance_vel_range	8	D	Polar Coordinate,	Meter/Sec
52.	target_snr	4	F		

53.	target_hpt	1	B			0-NO 1-HPT 2-STT
54.	Spare5	1	B			
55.	Spare6	1	B			
56.	Spare7	1	B			
57.	Spare8	4	F			

5.2.2.1   Targets Data

Message Name : Targets Data
Message Code/Id : 0xCEF00403
Message Size : 16624 Bytes
In/Out Type : Out
Rate : 1 Hz
Timing Constraints :
Acknowledge Required :
Validation : None
Message Ability :
Description : Targets data message to C2 system contains up to 50 targets in message, in case there are more than 50 target the message will send multiple times. the message applicable in operate state
Message Words : See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	targetCount	4	UL	Number of targets	
3.	targetdata[0:49]	332*50		See section 5.2.2	

5.2.2.2   Single Target Data

Message Name   :   Single Target Data
Message Code/Id   :   0xCEF00404
Message Size   :   352 Bytes
In/Out Type   :   Out
Rate   :   On change (Track New/Update/delete).
Timing Constraints   :
Acknowledge Required   :
Validation   :   None
Message Ability   :
Description   :   Single Target data message to C2 contain single target.
Message Words   :   See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	targetdata	332		See section 5.2.2	

5.2.2.3   Single Target Extended Data

Message Name   : Singel Target Extended Data
Message Code/Id   : 0xCEF00414
Message Size   : 528 Bytes
In/Out Type   : Out
Rate   : On change (Track New/Update/delete).
Timing Constraints   :
Acknowledge Required   :
Validation   : None
Message Ability   :
Description   : Single Target data message to C2 contain single target including Track and Plot.
Message Words   : See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	targetdata	332		**See section 5.2.2**	
3.	plot_time	8	I_64	Plot update time	Mili Sec From midnight
4.	plot_id	4	UL		
5.	plot_elevation	8	D	Polar Coordinate	[Rad] [-pi/2 : pi/2]
6.	plot_azimuth	8	D	Polar Coordinate	[Rad] [-pi : pi]
7.	plot_range	8	D	Polar Coordinate	Meters
8.	plot_dopler	4	F		Meters/sec
9.	plot_snr	4	F		DB
10.	plot_sigma_elevation	8	D	Polar Coordinate	[Rad] 0 : 2*pi]
11.	plot sigma_azimuth	8	D	Polar Coordinate	[Rad] [0: 2*pi]
12.	plot sigma range	8	D	Polar Coordinate	Meters
13.	plot sigma dop	4	F		Meters^2
14.	spare[0:15]	4*16	F		

Notes:

- **See Appendix A, Attach to this document .**
- **When target is delete only targetId and target status fiels are relevants.**
- **Target position data is relative to the north asuuming motion message is available and send form C2/INS to the system.**
- **In case of target status Field is Extrapolate plot data in not relevant .**
- **It might occur that a target report shall appear without the INIT status(targetstatus field) because of radar filtering conditions.**

5.2.3 Bit Status Data

Message Name	: Bit Status Data
Message Code/Id	: 0xCEF00406
Message Size	: 1344 Bytes
In/Out Type	: Out
Rate	:
Timing Constraints	:
Acknowledge Required	:
Validation	: None
Message Ability	:
Description	: Bit Status data message contain information of the Hardware and Software state

The system will inform the C2 system with the system BIT results.

This message will be used in the following scenarios:

1. In completion of the PBIT (Power up BIT) process, PBIT process will be apply on initialization of the radar system.
2. In completion of the CBIT (Continues BIT) process (send 1 sec periodically).
3. In response to BIT request message after completion of the IBIT process. The message will contain the errors generated during the IBIT tests.

Message Words   : See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	noErrors	4	UL		0-10
3.	errorId	4	UL		See Appendix B
4.	errorSeverity	4	ENUM		0 = WARNING 1 = INTERMEDIATE 2 = SEVERE
5.	Category	4	ENUM		1 = Operator
6.	Error State	4	ENUM		0 = Exists 1 = Vanished 2= REPEATED 3 = NOT_EXIST
7.	errorDataStruct	100	C	String error description	
8.	Spare1	4	UL		
9.	Spare2	4	UL		
10.	Spare3	4	UL		
11.	Spare4	4	UL		
Fildes 3-11 repeat 10 times					

5.2.4 Maintenance Data

Message Name	:	Maintenance Data
Message Code/Id	:	0xCEF00407
Message Size	:	2008 Bytes
In/Out Type	:	Out
Rate	:	
Timing Constraints	:	
Acknowledge Required	:	
Validation	:	None
Message Ability	:	
Description	:	The Message contain version data including SW and FW version number of all system components. message send accordance to the maintenance request from the C2
Message Words	:	See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	System_major	2	US	System Major Release	
3.	System_minor	2	US	System Minor Release	
4.	System_revision	2	US	System Revision	
5.	System_build	2	US	System Build Number	
6.	System_part_number	10	C	System part number	String
7.	System_serial_number	10	C	System serial number	string
8.	componentSW_Name	20	C	componentName String	string
9.	componentSW_ver_major	2	US	Major Release	
10.	componentSW_ver_minor	2	US	Minor Release	
11.	componentSW_ver_revision	2	US	Build Number	
12.	componentSW_ver_build	2	US	part number	
13.	componentSW_type	4	ENUM		See Appendix C
Fields 8-13 repeat 30 times					
14.	componentFW_Name	20	C	componentName String	string
15.	componentFW_ver_major	2	US	Major Release	
16.	componentFW_ver_minor	2	US	Minor Release	
17.	componentFW_ver_revision	2	US	Build Number	
18.	componentFW_ver_build	2	US	part number	
19.	componentFW_type	4	ENUM		See Appendix C
Fields 14-19 repeat 30 times					
20.	Spare[0-9]	4*10	UL		

5.2.5 Acknowledge

Message Name : Acknowledge Message
Message Code/Id : 0xCEF00405
Message Size : 56 Bytes
In/Out Type : Out
Rate :
Timing Constraints :
Acknowledge Required :
Validation : None
Message Ability :
Description : Acknowledge message send in case of Acknowledge is required for some request or control message
Message Words : See table below.

| No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	Acknowledge	4	ENUM		0 = REJECT 1 = OK
3.	refer message	4	ENUM		1=RESOURCE_REQ
4.	refer Sequence number	4	UL		Acknowledge to refer seq number of requests form the block header
5.	Reject Reason	4	ENUM		TBD
6.	Spare1	4	UL		
7.	Spare2	4	UL		
8.	Spare3	4	UL		
9.	Spare4	4	UL		
10.	Spare1	4	UL		

5.2.6 Sensor Position

Message Name : Sensor Position Message
Message Code/Id : 0xCEF0041A
Message Size : 92 Bytes
In/Out Type : Out
Rate :
Timing Constraints :
Acknowledge Required :
Validation : None
Message Ability :
Description : The message will send as response to set sensor position message and contain the current installation data for each sensor.
Message Words : See table below.

No.	Field Name	Size (Bytes)	Type	Description	Encoding
1.	Message Header	20		See section 3.2	
2.	Sensor	4	ENUM		RADAR_1 = 0 RADAR_2 = 1 RADAR_3 = 2 RADAR_4 = 3 HFL_1 = 4 HFL_2 = 5 HFL_3 = 6 HFL_4 = 7 GFP_1 = 8 GFP_2 = 9
3.	pitch	8	D	right hand rool	Rad [-pi/2 : pi/2]
4.	roll	8	D	right hand rool	Rad[-pi/2 : pi/2]
5.	yaw	8	D	right hand rool	Rad[-pi : pi]
6.	X	8	D	North (NED)	meter
7.	Y	8	D	East (NED)	meter
8.	Z	8	D	Down (NED)	meter
9.	Spare1	4	UL		
10.	Spare2	4	UL		
11.	Spare3	4	UL		
12.	Spare4	4	UL		
13.	Spare5	4	UL		

6. Message Sequencing

The following figure represent the messages sequence between the ELM-2135 and C2 System.
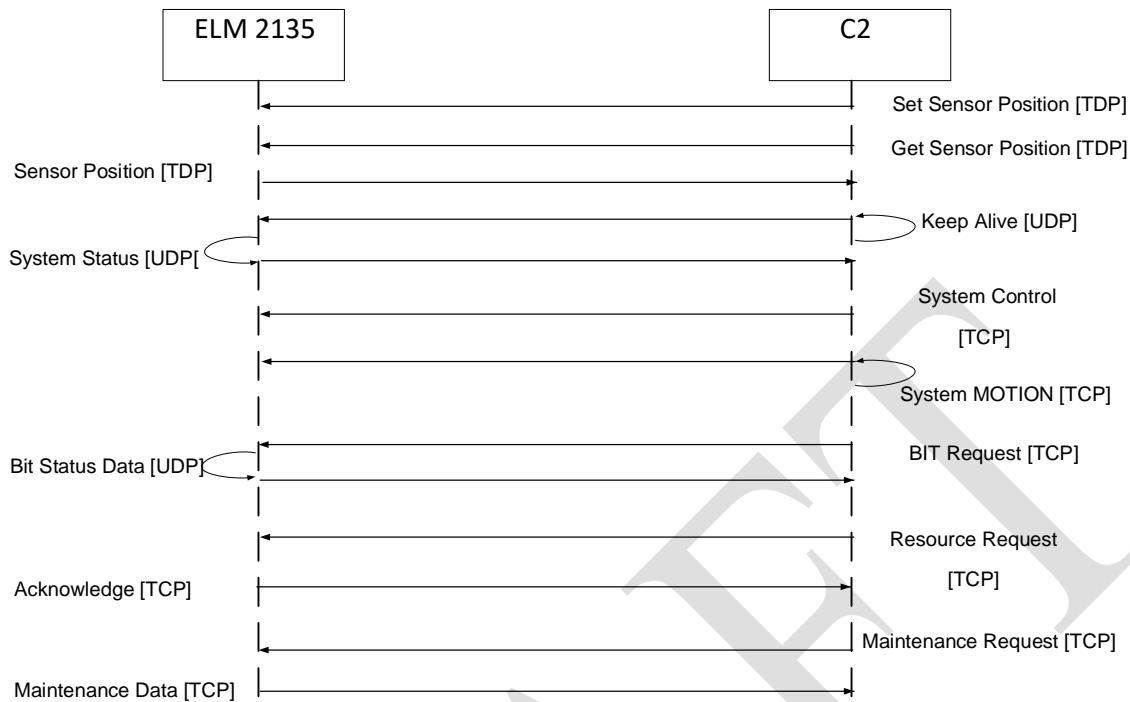
6.1 InitState

At the end of the initialization process, the radar is in standby mode and ready to move to operate.

The Radar will respond with Status message every ~1 second and will ask for acknowledge for any (3) statuses (~3 sec).

keep alive message should be response in less than 3sec. otherwise the Radar will decide "loss of communication" and will restart all connection sockets

6.2 Standby State

The External system shall send the radar a System Control message to command the Radar to move to operate state
.
The Radar will respond with Status message every ~1 seconds and will ask for acknowledge for any (3) statuses. (~3 sec).

keep alive message should be responded in less than 3sec, otherwise the Radar will decide "loss of communication" and will restart all connection sockets.

6.3 OperateState

In Operate state, reports are sent to C2 System.

Target data message using TCP sockets.

Status message every ~1 second and will ask for acknowledge for any
(3) statuses (~3 sec), using UDP sockets.

keep alive message should be responded in less than 3sec. otherwise the
Radar will decide "loss of communication" and will restart all connection sockets.

The operator can move to STANDBY state using System Control message .

6.4 Mode transition roles

Current Mode / New Mode	Init	Standby	Operational	Maint.
Init		X	X	X
Standby	✓		✓	✓
Operational	X	✓		X
Maintenance	X	✓	X	