AISG Extension: Remote Azimuth Steering

Remote Azimuth Steering Extension to the Control Interface for Antenna Line Devices

Supplementary to AISG Standard No. AISG version 2.0

Revision History

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1. FOREWORD

The Antenna Interface Standards Group (AISG) published the AISG standard to facilitate the introduction of antenna line products with remote control and monitoring facilities. The purpose of that standard is to ensure basic interoperability of antennas and control infrastructure. The AISG standard covers two basic types of Antenna Line Devices: actuators capable of altering the electrical downtilt of the antenna and tower mounted amplifiers.

It has become evident that commercial antenna line devices are evolving beyond this set of capabilities. The AISG has decided to publish extensions to the basic standard rather than adding all possible branches to the core specification. For purposes of compliance, users should note that this entire Extension Standard is *optional*. However, once this Extension Standard is elected for inclusion in a device, the entire option becomes mandatory.

This extension to the AISG standard adds procedures for antenna line devices that implement control of the antenna beam direction in the azimuth plane, a process referred to in this document as *remote azimuth steering.*

2. SCOPE

This document contains extensions to layers 2 and 7 of AISG specification, version 2.0 [1], for antennas implementing Remote Azimuth Steering control (RAS).

3. REFERENCES

This AISG Extension Standard incorporates provisions from other publications. These are cited in the text and the referenced publications are listed below. Where references are dated, subsequent amendments or revisions of these publications apply only when specifically incorporated by amendment or revision of this AISG extension. For undated references the latest edition of the publication referred to applies.

1 AISG Version 2.0, “Control Interface for Antenna Line Devices”

2 3GPP TS25.460 UTRAN Iuant Interface General Aspects and Principles Release 6

3 3GPP TS25.461 UTRAN Iuant Interface Layer 1, Release 6

4 3GPP TS25.462 UTRAN Iuant Interface Signalling Transport, Release 6

5 3GPP TS25.463 UTRAN Iuant Interface Remote Electrical Tilting (RET), Release 6

6 AISG Extension Standard #, Generic Devices

7 3GPP TS25.466 UTRAN Iuant Interface: Application Part, Release 7

Note the 3GPP references are to Release 6 unless otherwise indicated. These documents are referred to in AISG Version 2.0, although they may have been superseded.

4. ABBREVIATIONS

Where abbreviations or acronyms are used in this document they have the following meanings:

ALD	Antenna Line Device
RET	Remote Electrical Tilt
RAS	Remote Azimuth Steering
TCP	Time Consuming Procedure

5. TERMINOLOGY AND DEFINITIONS

Where the following terms are used in this document, they have the meanings listed below.

Azimuth bearing	The direction orthogonal to the axis of the antenna assembly, expressed in degrees East of True North (ETN). Also referred to as Antenna Bearing in Appendix D.
Azimuth Offset	The angle, expressed in degrees, between the azimuth bearing of an antenna and the maximum of its main beam in the azimuth plane. A positive azimuth offset means that the antenna beam is directed to a compass heading numerically greater than the azimuth bearing. An antenna has separate values for azimuth bearing and azimuth offset. The azimuth bearing is fixed by the geometry of the installation. The azimuth offset is remotely controllable and variable.
Remote Azimuth Steering device (RAS)	Antenna line device provided with means by which the azimuth offset of its main beam is varied in response to received commands.
Overload(ed)	A procedure code is said to be overloaded when the same code from a referenced document is re-used for another, similar purpose in this Extension Standard. For example, the code 0x74, which is defined as TMASetDeviceData in [1], is to be interpreted as RASSetDeviceData within this Extension Standard.
Subunit	An RAS may comprise more than one RAS subunit combined in a single physical entity. All RAS subunits within one RAS unit have the same layer 2 HDLC address and are separately addressed via layer 7 procedures.

6. LAYER 1

All definitions and specifications for RET devices in references [1], [2] and [3] regarding Iuant layer 1 apply to Remote Azimuth Steering devices complying with this Extension Standard unless otherwise stated by requirements in this document.

6.1. Normal operation

6.1.1. RAS DC power consumption

During movement of RAS subunits, ALD power consumption shall remain compliant with the same specifications as RET subunits [5].

6.1.2. RAS Power-up characteristics

Devices complying with this Extension Standard shall have a maximum power-up period of 3 seconds.

After the power-up period, the device shall be fully functional.

6.2. Resumption of operation after interruption of supply

Normal operation shall be resumed after restoration of the power supply after any interruption or arbitrary reduction of the voltage supplied (brown-out) in accordance with [3].

Data to be retained shall include data relating to operational settings and user data; it shall not include address or alarm settings (see [3 and 4]).

6.2.1. RASs not requiring continuous DC power

There shall be no loss of the current set azimuth offset, nor shall there be any autonomous movement or operation by the subunit.

These systems may be left un-powered for extended periods and will be expected to resume normal operation as soon as power is applied.

6.3. Unintended or interrupted movement

In the event that the RAS detects unintended movement or fails to complete a commanded movement, then the alarm ActuatorInterference shall be set unless another more appropriate alarm is set. (for example ActuatorJam, NotCalibrated, etc).

7. LAYER 2

All definitions and specifications for antenna line devices (ALDs) in references [1] and [4] regarding Iuant Layer 2 shall be valid for all ALDs included in this Extension Standard regardless of whether the device implements any other functionality.

Extended specifications for layer 2 are defined in the following chapter.

7.1. Device Type

The following table shows the additional device type for this Extension Standard:

Table 7.1-1: Device type

Device Type	**1-octet unsigned integer**
Remote Azimuth Steering	0x20

Any RAS device shall be defined as part of a generic device. For the purposes of reverse compliance with [1] and [4], devices implementing this Extension Standard shall report the device type in compliance with provisions in [6].

8. LAYER 7

The application layer includes the common elementary procedures as defined in [1] and [5] and is extended by AISG-specific procedures.

8.1. General Aspects

8.1.1. Geometry and Numbering

All RAS devices shall be defined as multiple subunit devices. Devices with single RAS units shall be implemented as multiple subunit devices with the number of subunits equal to 1.

8.1.2. Parallel Procedure Handling for Time Consuming Procedures (TCPs)

The following table extends the Common Procedure Sets in [5] and [7] to include elementary procedures defined within this specification.

Table 8.1.2-1: Definition of TCPs and the execution of procedures concurrent with a TCP

Elementary Procedure	TCP	Execution concurrent with a TCP
RASSetDeviceData	no	disallowed
RASGetDeviceData	no	disallowed
RASAlarmIndication	no	disallowed
RASClearActiveAlarms	no	disallowed
RASGetAlarmStatus	no	mandatory
RASSetAzimuthOffset	yes	disallowed
RASGetAzimuthOffset	no	disallowed
RASSendConfigurationData	no	disallowed
RASCalibrate	yes	disallowed
RASGetSupportedFunctions	no	disallowed
RASGetNumberOfSubunits	no	mandatory
RASGetSupportedNonLinearOffsetValues	no	disallowed

8.2. Return and alarm codes

An annotated table of return and alarm codes is given in [5].

8.3. Common Elementary Procedures for Remote Azimuth Steering

To avoid prematurely exhausting the available space in the command table through the proliferation of extensions, certain codes defined for other devices are reused by this extension. This process is called “overloading”.

For all device subunits compliant with this extension, the overloaded code shall refer to a member of the RAS procedure set defined herein, and not to the procedure assigned by the original specification.

This section defines those procedures that are defined by overloading existing procedure codes without any significant changes in the procedure initiation message, response message, and/or return code values. For clarity, only differences from the language of the referenced specification are elaborated for these procedures.

Table 8.3-1 Elementary procedures specified for multi-antenna device types

Azimuth Command	Overloads	Code Value	Requirement
RASSetDeviceData	TMASetDeviceData [1]	0x74	mandatory
RASGetDeviceData	TMAGetDeviceData [1]	0x75	mandatory
RASAlarmIndication	TMAAlarmIndication [1]	0x76	mandatory
RASClearActiveAlarms	TMAClearActiveAlarms [1]	0x77	mandatory
RASGetAlarmStatus	TMAGetAlarmStatus [1]	0x78	mandatory
RASGetNumberOfSubunits	TMAGetNumberOfSubunits [1]	0x79	mandatory

These commands shall be implemented as specified in the corresponding paragraphs of [1], except that the term “TMA” shall be replaced by “RAS”.

8.4. Device-Specific Elementary Procedures for RAS Subunits

This section defines procedures that are defined by overloading existing procedures in [1] and [5] that include significant changes in the procedure message initiation, response, and/or return code values or formats. For clarity, these procedures are defined completely. No requirements from the corresponding procedure clauses in [1] or [5] shall be inferred unless re-stated in this Extension Standard.

Table 8.4-1 Azimuth Steering specific elementary procedures

Azimuth Command	Overloaded command	Code Value	Requirement
RASSetAzimuthOffset	AntennaSetTilt [5]	0x81	mandatory
RASGetAzimuthOffset	AntennaGetTilt [5]	0x82	mandatory
RASSendConfigurationData	AntennaSendConfigurationData [5]	0x89	optional
RASCalibrate	AntennaCalibrate [5]	0x80	optional
RASGetSupportedFunctions	TMAGetSupportedFunctions [1]	0x7A	mandatory
RASGetSupportedNonLinear OffsetValues	TMAGetSupportedNonLinearGain Values [7]	0x7B	optional

8.4.1. RAS Set Azimuth Offset

The demanded azimuth offset shall be in the range -180 to +179.9 degrees. The format of this parameter shall be a signed integer expressed as azimuth offset value times 10.

The azimuth offset shall be accepted if:

- AZmin ≤ AZdemanded ≤ AZmax
- For linear-steps, AZdemanded = AZmin + n*AZresolution, when n is a non-negative integer.
- For non-linear steps, AZdemanded must be equal to a supported value.

Where AZmin and AZmax are the minimum and maximum values of azimuth offset, AZdemanded is the demanded azimuth offset and AZresolution is the control increment.

AZmin, AZmax, and AZresolution are reported by RASGetSupportedFunctions.

For all other values of AZdemanded, the subunit shall respond with return code UnsupportedValue [1].

The actual compass bearing of the centre of the antenna beam may be derived by summing the azimuth offset (in degrees) and the “bearing” field of Annex B [5] for this subunit.

Azimuth offset adjustments shall not affect other configurable parameters.

The response time to this procedure shall be less than 2 minutes.

Note: The use of 0.1 degree increments for data representation, as implied above, is to be consistent with related data items and shall not be taken as a guarantee of that degree of accuracy.

Table 8.4.1-1: Elementary procedure RASSetAzimuthOffset

Name: **RASSetAzimuthOffset**				
Code:	Issued by:	Procedure class:	DownloadMode state:	Power mode:
0x81	**Primary device**	**1**	**No**	**High**

Table 8.4.1-2: Initiating message parameters and format for RASSetAzimuthOffset

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number
2	2 octets	Signed integer	Azimuth offset

Table 8.4.1-3: Response message parameters and format for RASSetAzimuthOffset

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number
2	1 octet	Return code	Return code: OK

Table 8.4.1-4: Return codes for RASSetAzimuthOffset

OK	FAIL	Comment
	FormatError	
	Busy	See [5]
	HardwareError	
	WorkingSoftwareMissing	
	MotorJam	
	ActuatorJam	
	NotConfigured	
	NotCalibrated	
	OutOfRange	

8.4.2. RAS Get Azimuth Offset

The azimuth offset returned shall be in the range -180 to +179.9 degrees. The format of this parameter shall be a signed integer expressed as azimuth offset value times 10.

The actual compass bearing of the centre of the antenna beam may be derived by summing the azimuth offset (in degrees) and the "bearing" field of Annex B [5] for this subunit.

The use of 0.1 degree increments for data representation is to be consistent with related data items and shall not be taken as a guarantee of that degree of accuracy.

Table 8.4.2-1: Elementary procedure RASGetAzimuthOffset

Name: **GetAzimuthOffset**				
Code:	Issued by:	Procedure class:	DownloadMode state:	Power mode:
0x82	**Primary device**	**1**	**No**	**Low**

Table 8.4.2-2: Initiating message parameters and format for RASGetAzimuthOffset

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number

Table 8.4.2-3: Response message parameters and format for RASGetAzimuthOffset

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number
2	1 octet	Return code	Return code: OK
3	2 octets	Signed integer	Azimuth offset

Note that response parameter 3 is not required unless the return code = OK

Table 8.4.2-4: Return codes for RASGetAzimuthOffset

OK	FAIL	Comment
	FormatError HardwareError WorkingSoftwareMissing NotConfigured NotCalibrated	See [5]

8.4.3. RAS Send Configuration Data

On receipt of the initiating message the secondary device shall store the provided vendor and antenna specific configuration data for the relationship between the movement of the drive system and the azimuth offset position of the antenna.

If the configuration data exceeds (MaxDataReceiveLength–1), the data shall be split into a number of segments of length (MaxDataReceiveLength–1) and one final segment containing the remaining data. The primary device transmits the segments in order. The layer 2 sequence numbers guarantee that no segment will be lost or received out of order.

Table 8.4.3-1: Elementary procedure RASSendConfigurationData

Name: RASSend**ConfigurationData**				
Code:	Issued by:	Procedure class:	DownloadMode state:	Power mode:
0x89	**Primary device**	**1**	**No**	**Low**

Table 8.4.3-2: Initiating message parameters and format for RASSendConfigurationData

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number
2	Less than, or equal to (MaxDataReceive-Length–1)	Vendor specific	Configuration data

Table 8.4.3-3: Response message parameters and format for RASSendConfigurationData

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number
2	1 octet	Return code	Return code: OK

Table 8.4.3-4: Return codes for RASSendConfigurationData

OK	FAIL	Comment
	FormatError Busy HardwareError WorkingSoftwareMissing ChecksumError InvalidFileContent UnsupportedProcedure	See [5]

8.4.4. RAS Calibrate

On receipt of the initiating message the RAS shall perform a calibration of the RAS addressed by the subunit number. During calibration the azimuth offset may be driven through the whole azimuth offset range.

The response time to this procedure shall be less than 4 minutes.

Table 8.4.4-1: Elementary procedure RASCalibrate

Name: RASCalibrate				
Code:	Issued by:	Procedure class:	DownloadMode state:	Power mode:
0x80	**Primary device**	**1**	**No**	**High**

Table 8.4.4-2: Initiating message parameters and format for RASCalibrate

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number

Table 8.4.4-3: Response message parameters and format for RASCalibrate

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number
2	1 octet	Return code	Return code: OK

Table 8.4.4-4: Return codes for RASCalibrate

OK	FAIL	Comment
	FormatError Busy HardwareError MotorJam ActuatorJam WorkingSoftwareMissing NotConfigured UnsupportedProcedure	See [5]

8.4.5. RAS Get Supported Functions

On receipt of the initiating message, the secondary device shall respond with the function flags and parameters indicating the supported functionality of the addressed Azimuth Offset actuator.

Function Flags are numbered as described in [1].

If the device only supports a number of fixed values for Azimuth Offset, it shall report an Azimuth Resolution value of "0". The supported values may be determined by using the command RASGetSupportedNonLinearOffsetValues (see Para 8.4.6).

Table 8.4.5-1: Elementary procedure RAS Get Supported Functions

Name: **RASGetSupported Functions**				
Code:	Issued by:	Procedure class:	DownloadMode state:	Power mode:
0x7A	**Primary device**	**1**	**No**	**Low**

Table 8.4.5-2: Initiating message parameters and format for RASGetSupportedFunctions

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number

Table 8.4.5-3: Response message parameters and format for RASGetSupported Functions

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number
2	1 octet	Return code	Return code: OK
3	1 octet	Unsigned integer	Function Flags
4	2 octets	Signed integer	Minimum azimuth offset (AZmin) expressed in offset values times 10.
5	2 octets	Signed integer	Maximum azimuth offset (AZmax) expressed in offset values times 10.
6	2 octets	Unsigned integer	Azimuth offset resolution [degrees] (AZresolution) expressed as resolution value times 10, or 0 if the device only supports non linear offset values.

Table 8.4.5-4: Return codes for RASGetSupportedFunctions

OK	FAIL	Comment
	FormatError Busy WorkingSoftwareMissing	See [5]

Table 8.4.5-5: Function Flags for RASGetSupportedFunctions

Number	Description
0	Set to 1 if subunit supports RASSendConfigurationData procedure, 0 otherwise.
1	Set to 1 if subunit supports the procedure RASCalibrate, 0 otherwise.
2	Unused
3	Unused
4	Unused
5	Unused
6	Unused
7	Unused

8.4.6. RAS Get Supported Non-Linear Offset Values

In response to the command RASGetSupportedNonLinearOffsetValues, the secondary device shall respond with a message containing a list of supported values in numerically ascending order, preceded by the number (N) of such values contained in the list.

Table 8.4.6-1: Elementary procedure RASGetSupportedNonLinearOffsetValues

Name: **RASGetSupportedNonLinearOffsetValues**				
Code:	**Issued by:**	**Procedure class:**	**DownloadMode state:**	**Power mode:**
0x7B	Primary device	1	No	n/a

Table 8.4.6-2: Initiating message parameters and format for RASGetSupportedNonLinearOffsetValues

Number	Length	Type	Description
1	1 octet	Unsigned integer	Subunit number

Table 8.4.6-3: Response message parameters and format for RASGetSupportedNonLinearOffsetValues

Number	Length	Type	Description
1	1 octet	Unsigned integer	Number of non linear offset values supported (N)
i+1	2 octets	Signed integer	Non linear offset supported value number i (expressed in offset value times 10)

I = 1..N

Table 8.4.6-4: Return codes RASGetSupportedNonLinearOffsetValues

OK	FAIL	Comment
	FormatError Busy WorkingSoftwareMissing UnsupportedProcedure	See [5]

9. VERSION MANAGEMENT

This chapter is not used in this Extension Standard

10. ADDITIONAL RECOMMENDATIONS

This chapter is not used in this Extension Standard

11. PRODUCT IDENTIFICATION

11.1. Marking of conforming products with extensions

In order to allow users to identify products which conform with the requirements of this extension standard, member companies are encouraged to use the AISG logo on conforming products and on any brochures, advertisements or product literature associated with them. In addition, the legends 'AISG 2.0 (Azimuth Steering Extension)' or 'Conforms with interface standard AISG 2.0 with Azimuth Steering Extension' may be used on such products and associated literature.

Annex A: Return Codes for Secondary AISG Devices (Normative)

The return codes listed in [5] annex A shall be used by secondary AISG devices.

Annex B: Re-Use of Assigned Fields for Additional Data (Normative)

The following fields defined in [5] Annex B, and [1] Annex C, are to be supported as described for information related to devices compliant with this Extension Standard. The following standard fields have no operational impact and are used by the procedures RASSetDeviceData and RASGetDeviceData.

Table B.1: Assigned fields for additional data

Field No.	Length (octets)	Format	Description	Additional Recommendations
0x01	15	ASCII	Antenna model number	
0x02	17	ASCII	Antenna serial number	
0x03	2	16-bit unsigned	Antenna operating bands	
0x04	8	4x16-bit unsigned	Beamwidth for each operating band in band order in degrees	
0x05	4	4x8-bit unsigned	Gain for each operating band in band order in tenths of dBi	
0x06	2	16-bit signed	Maximum permitted (positive) azimuth offset	Overloaded. Azimuth offset [degree], expressed as offset value times 10.
0x07	2	16-bit signed	Minimum permitted (negative) azimuth offset	Overloaded. Azimuth offset [degree], expressed as offset value times 10
0x21	6	ASCII	Installation date	
0x22	5	ASCII	Installer's ID	
0x23	32	ASCII	Base station ID	
0x24	32	ASCII	Sector ID	
0x25	2	16-bit unsigned	Antenna bearing (degrees)	
0x26	2	16-bit signed	Installed mechanical tilt	(degrees times 10)