FREQUENCY REGISTRATION FOR SMALL SATELLITE MISSIONS

BR-SSD e-Learning Center

ITU Radio Regulations Legal Framework

ITU Radio Regulations (RR)

- Part of the ITU Administrative Regulations and Instruments complementing the provisions of the ITU Constitution (CS) and Convention (CV), which govern the use of telecommunications
- ***Legal treaty - bindings on all Member states***
- Principles of use of orbit/spectrum (CS and RR)
- Allocation of frequency bands and services
- Procedures and Plans

Are we obliged to apply the ITU Radio Regulations?

- Ratification of the ITU Convention (CV) implies acceptance of the ITU Radio Regulations

Radio Regulations – useful sections for small satellite missions

- Article **1** Definitions
- Article **5** Table of Frequency Allocations
- Article **9** and **11** Procedures for the advance publication (API), coordination and notification
- Article **21/22** Power limits
- Article **25** Amateur and Amateur-satellite service
- Appendix **1** Classification of emissions
- Appendix **4** Data required for satellite filings

Obligations of an Admnistration under the Radio Regulatons for amateur satellite service

- No. **25.11 -** Administrations authorizing space stations in the amateur satellite service *shall ensure that sufficient earth command stations are established before launch to ensure that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated immediately* (see No. **22.1)**

- No. **22.1 -** space stations shall be fitted with devices to ensure immediate cessation of their radio emissions by telecommand, whenever such cessation is required under the provisions of these Regulations."

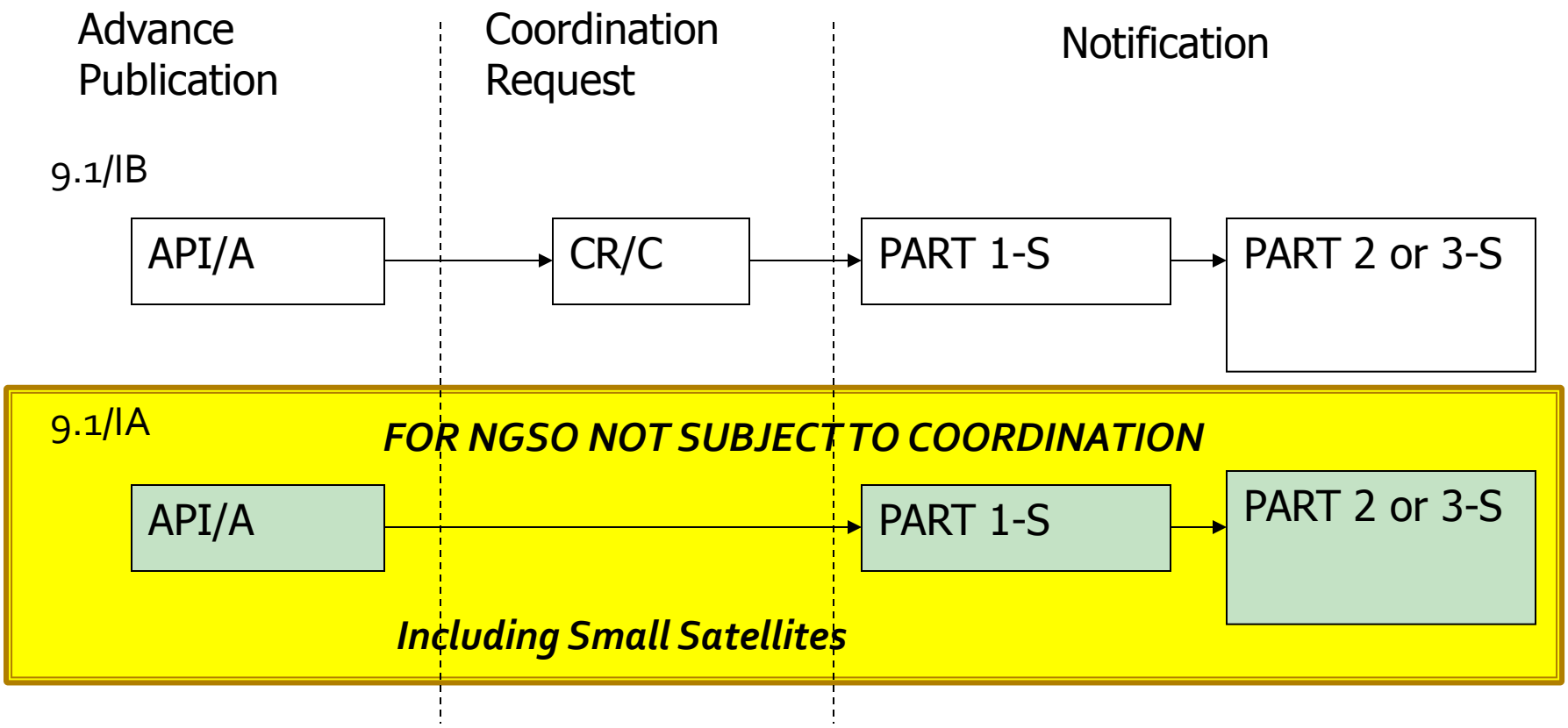
What assignments should be notified (No.11.2)?

- Any frequency assignments of transmitting and receiving earth and space stations
  - Capable of causing harmful interference; or
  - Used for international radiocommunication; or
  - Seeking to obtain international recognition; or
  - Non conforming assignment seeking to be recorded for information purposes only
  - …..

Which procedure is applicable for small satellite missions?

- Small satellite missions are generally NGSO systems which are not subject to any form of mandatory coordination. For such systems, the provisions of Article **9**, Sub-Section IA (*Advance publication of information on satellite networks or satellite systems that are not subject to coordination procedure under Section II*), are applicable.

Satellite network filing procedure



Frequency allocations for Amateur Satellite Service

Frequency band	Service	Type of allocation
28-29.7 MHz	Amateur-Satellite Service	Primary
144-146 MHz	Amateur-Satellite Service	Primary
435-438 MHz	Amateur-Satellite Service	Secondary (No.5.282)
1260 – 1270 MHz	Amateur-Satellite Service (E-S)	Secondary (No.5.282)
2400 – 2450 MHz	Amateur-Satellite Service	Secondary (No.5.282)
3400 – 3410 MHz	Amateur-Satellite Service	Secondary (No.5.282)
5650 – 5670 MHz	Amateur-Satellite Service (E-S)	Secondary (No.5.282)
5830 – 5850 MHz	Amateur-Satellite Service (S-E)	Secondary
…….		

For more details and the conditions for the usage of these bands, please refer to Article **5** of the Radio Regulations.

Frequency allocations for EESS usable for TT&C

Frequency band	Service	Type of allocation
401-403 MHz	EESS (E-S)	Primary
401-402 MHz	SOS (S-E)	Primary
1427 – 1429 MHz	SOS (E-S)	Primary
2025 – 2110 MHz	EESS (E-S, S-S) SOS (S-E, S-S)	Primary
2200 – 2290 MHz	EESS(S-E, S-S) SOS(S-E, S-S)	Primary
8025 – 8400	EESS (S-E)	Primary
13.75 – 14 GHz	EESS	Secondary
…….		

For more details and the conditions for the usage of these bands, please refer to Article 5 of the Radio Regulations.

Frequency allocations for EESS downlink usage

Frequency band	Service	Type of allocation
460-470 MHz	EESS (S-E)	Secondary
1690 – 1710 MHz	EESS (S-E)	Secondary
2200 – 2290 MHz	EESS (S-E)	Primary
8025 - 8400 MHz	EESS (S-E)	Primary
.....		

For more details and the conditions for the usage of these bands, please refer to Article 5 of the Radio Regulations.

What information is needed?

- Specified in Appendix **4** of the Radio Regulations, including:
  - Satellite name, responsible administration
  - Orbital characteristics
  - Antenna beam characteristics
  - Frequency band
  - Service Areas
  - Power levels/designation of emissions etc.
  - Earth stations

What information is needed ? (2)

- Sensors specific information
  - Active Sensors
    - Transmit beam
      - Mean peak power and mean power density
      - Pulse length and pulse repetition frequency
    - Receive beam
      - Receiver noise bandwidth
      - Noise temperature at output of signal processor
  - Passive sensors
      - Observed bandwidth
      - Sensitivity
  - To capture sensor information in Spacecap, go to Beam tab, check the box "Beam has Sensors"
  - Class of stations – E1, E2, E3, E4 (consult the Preface)
  - For the guide to capture of sensors, see ActiveandPassiveSensors.pdf

How to capture these information

- Make use of Spacecap for capturing information
- PDF or JPEG files can be submitted for antenna patterns
- Can add descriptions in PDF or Word format to supplement the information submitted in Spacecap

BRsoft

- The latest version of BR software for capture and validation of space notices are available from the ITU website (http://www.itu.int/ITU-R/go/space-software/en)
- They are also available with the BR IFIC DVD-ROM
- *For convenience of workshop participants, the latest version of these software have been included in the workshop CD-ROM.*
- The software needed for the preparation of satellite filings are:
  - SAM, Spacecap, SpaceVal, SpacePub

- Please install them on your PC if you wish to follow through the workshop.

CUBESAT

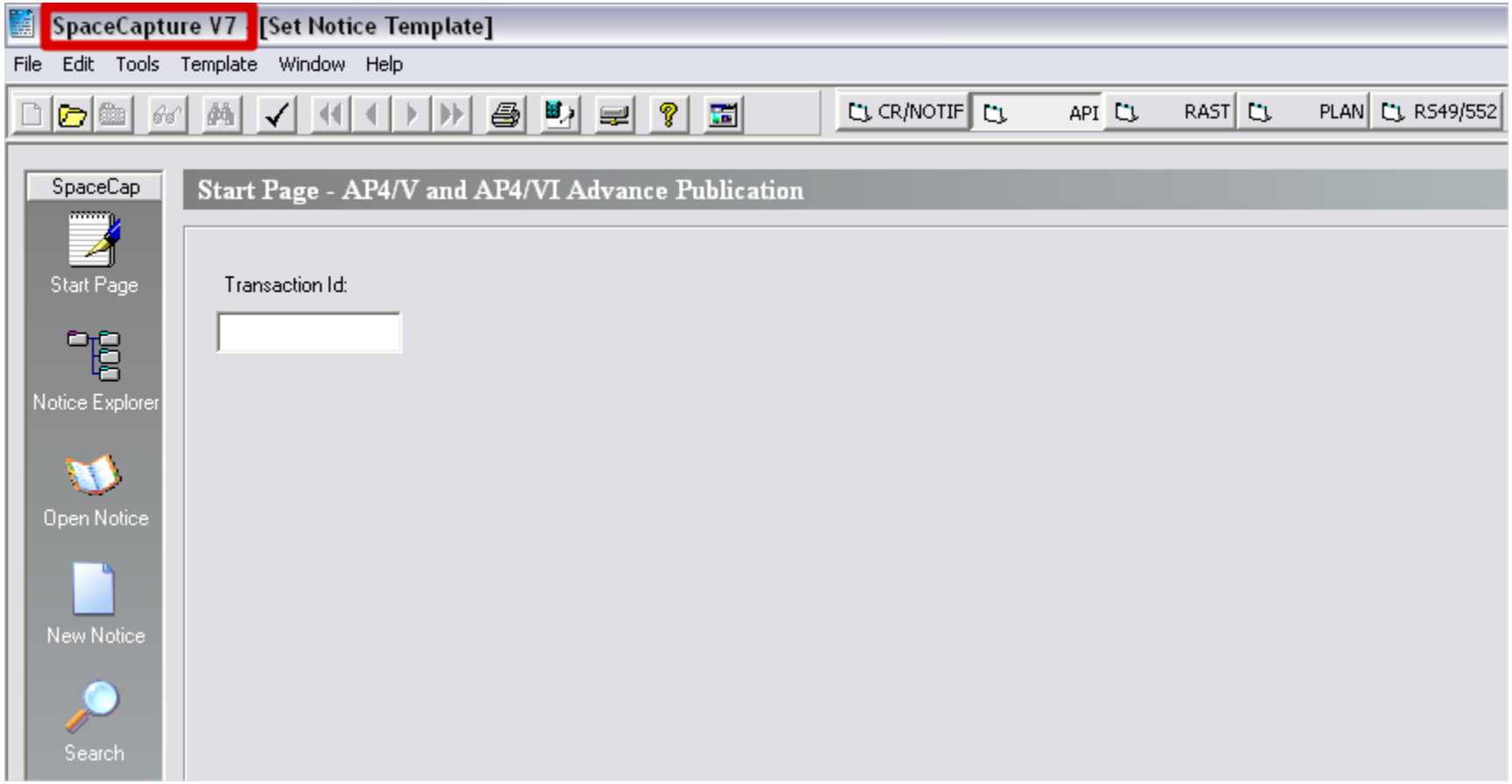
Advance Publication Information (API)

CAPTURE

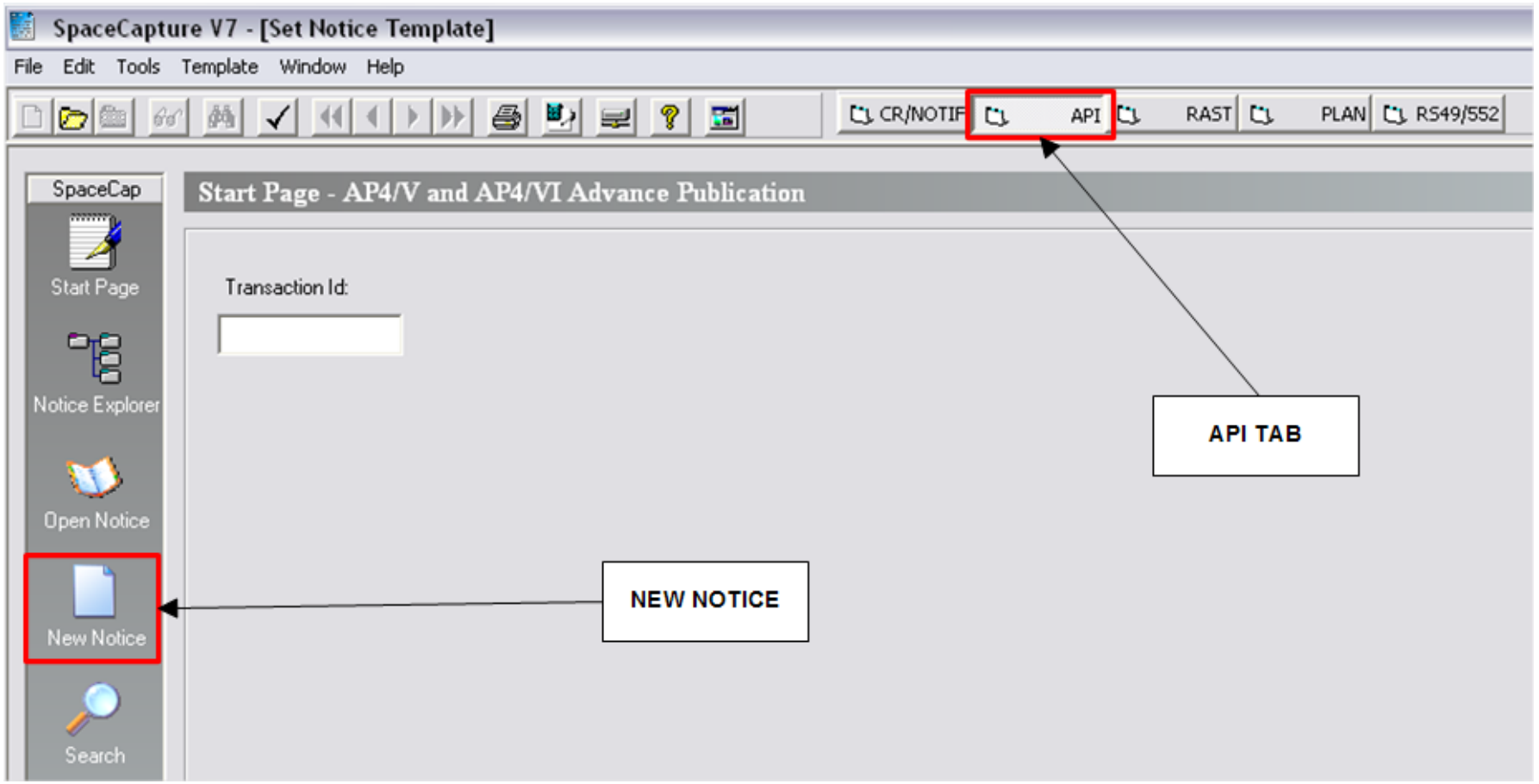
SPACECAP VERSION 7

Verify that you have the latest version of SpaceCap

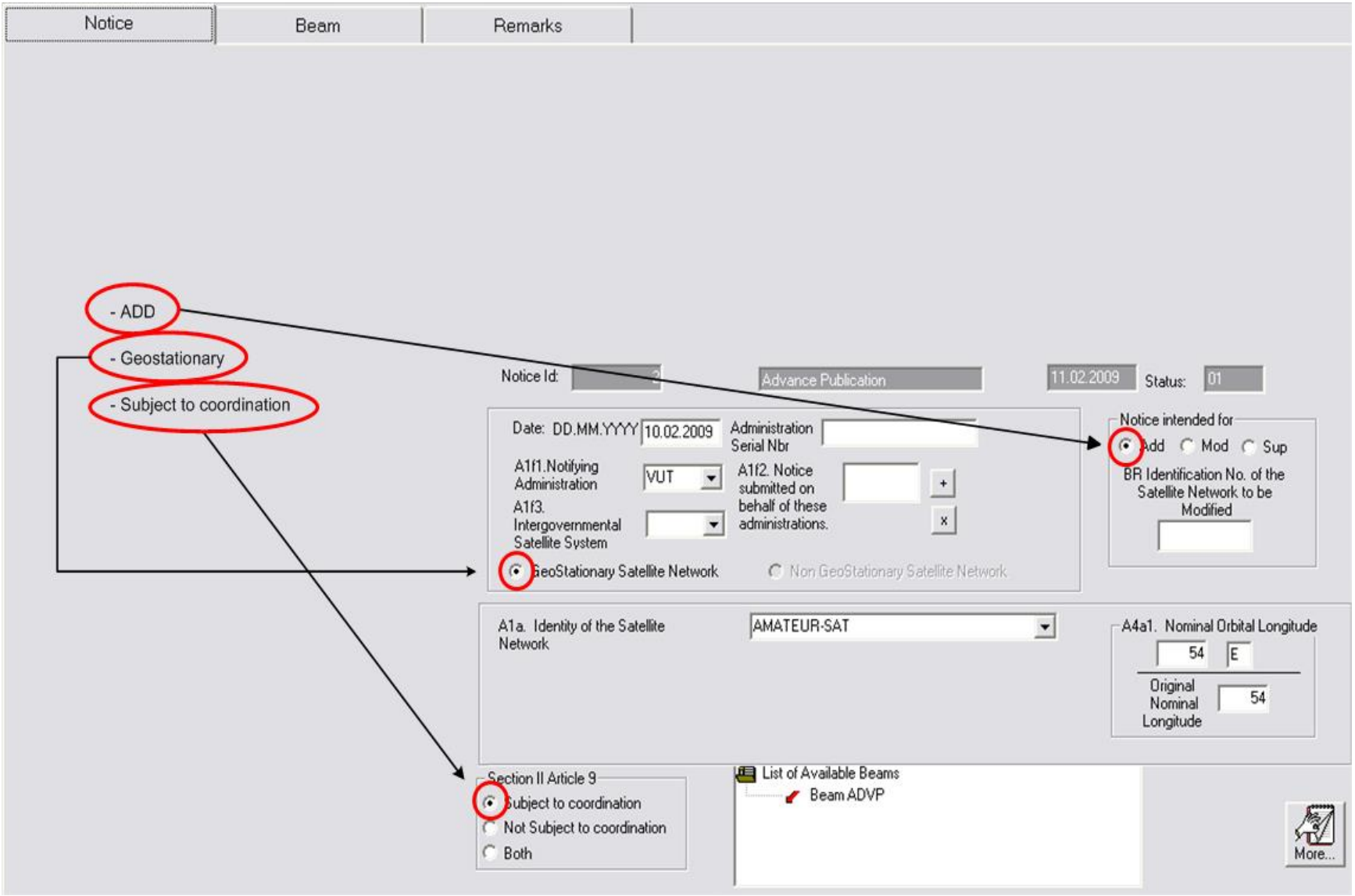
http://www.itu.int/ITU-R/go/space-software/



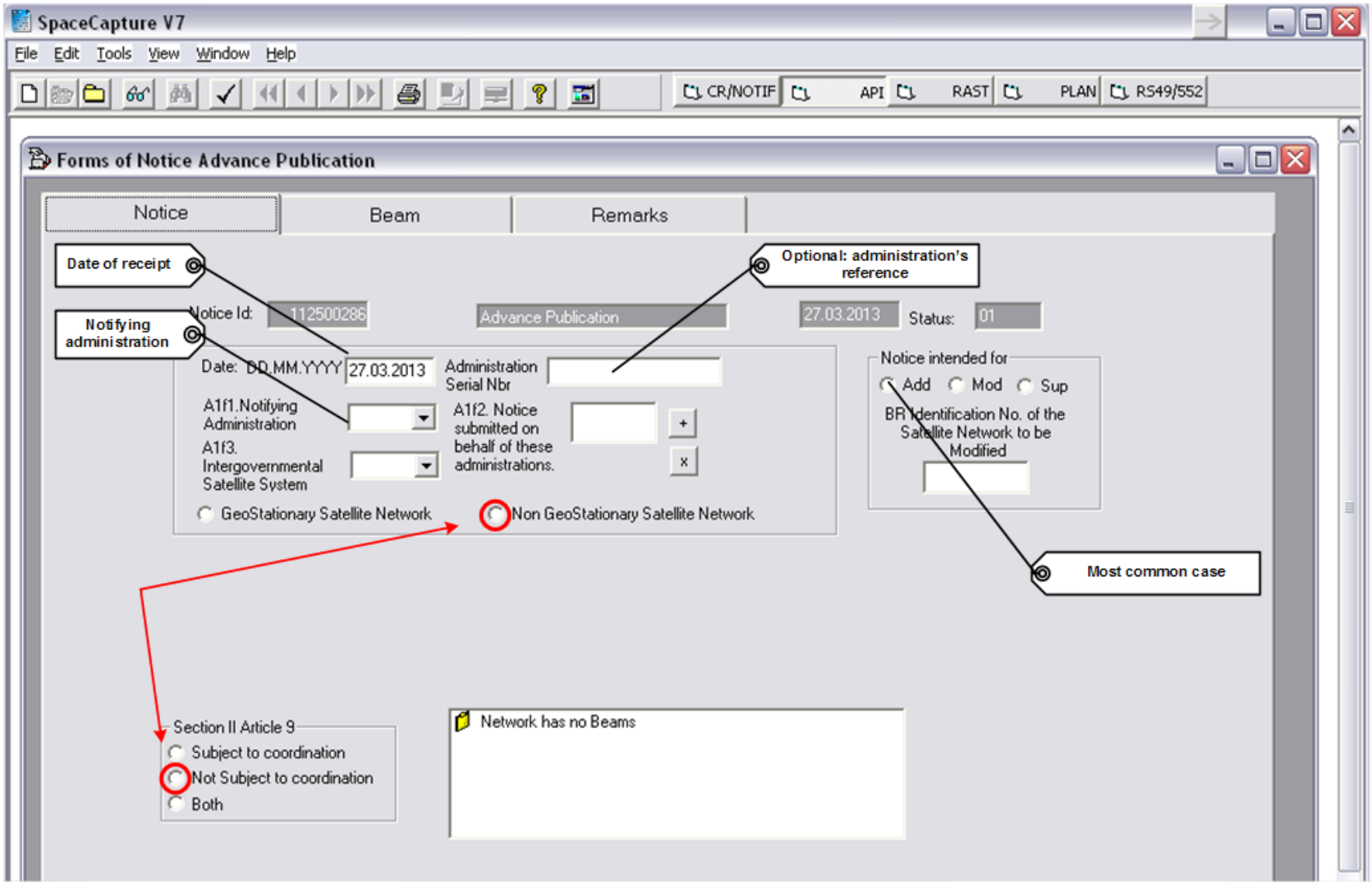
Select the API tab and New notice



By default the SpaceCap submission page will be:



Capture the main characteristics of the network

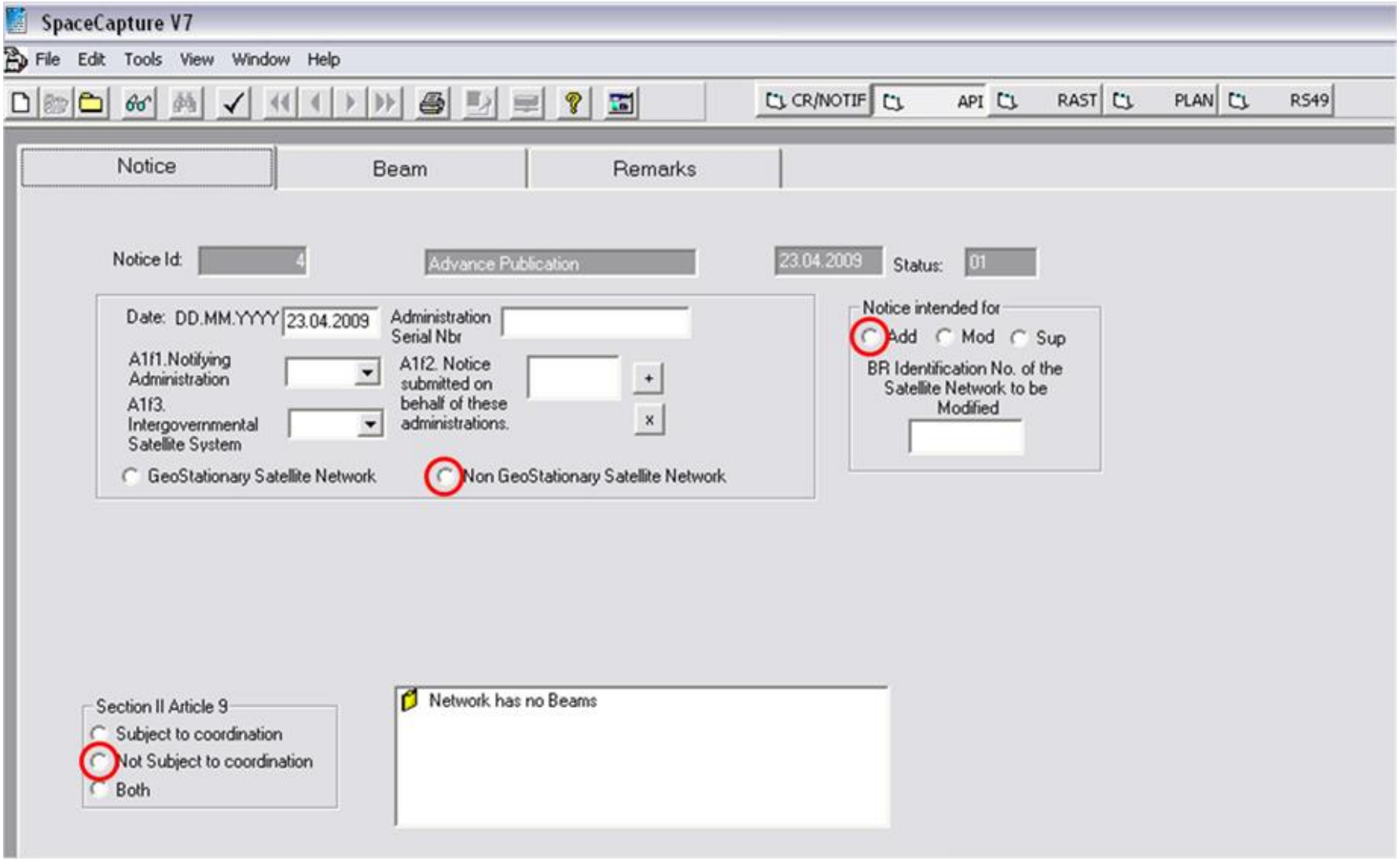


IT IS ASSUMED THAT IN MOST OF

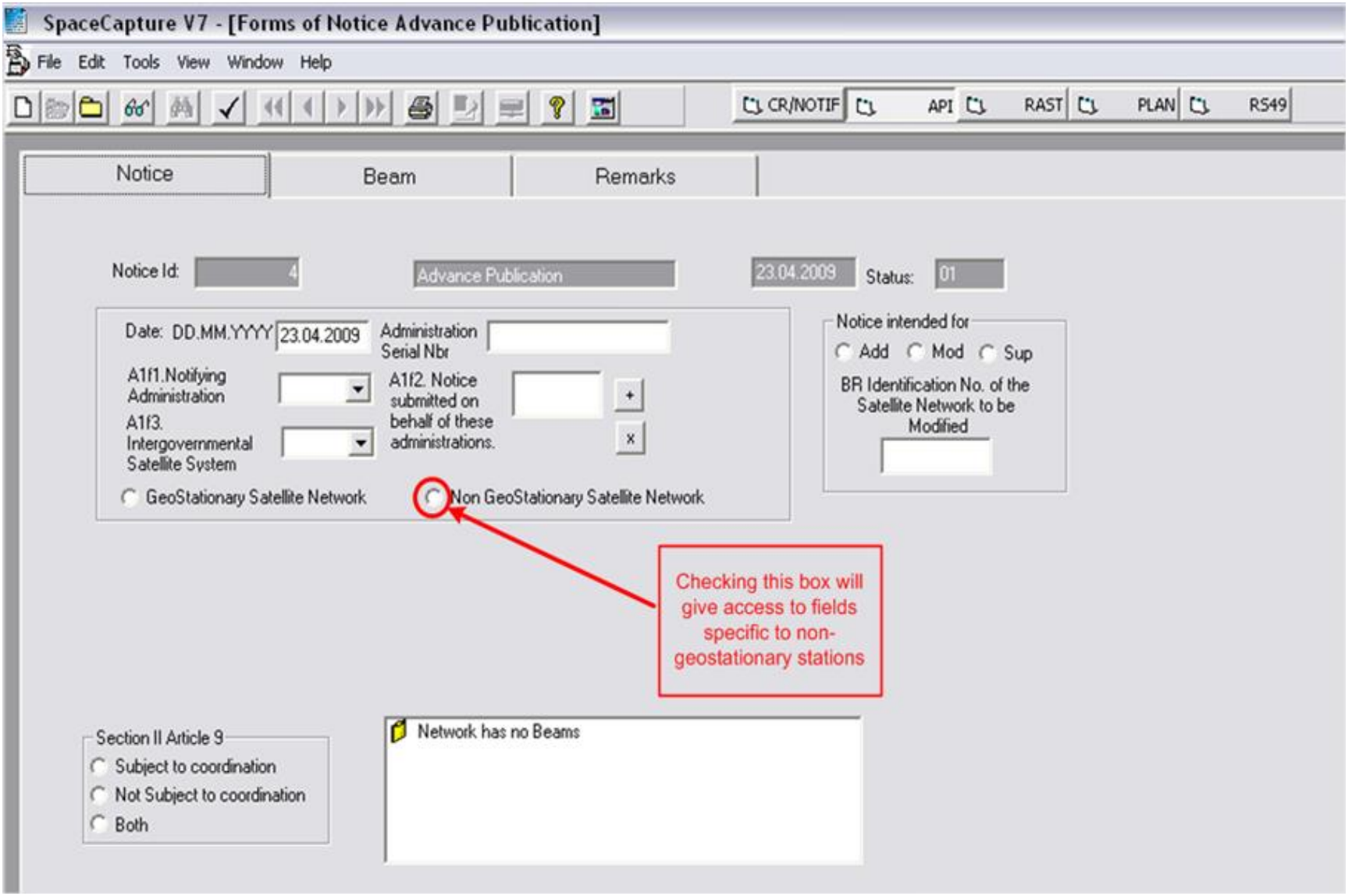
THE CASES, CUBESAT STATIONS ARE:

NOT SUBJECT TO COORDINATION

API CAPTURE APPROPRIATE ADJUSTEMENTS



NOTE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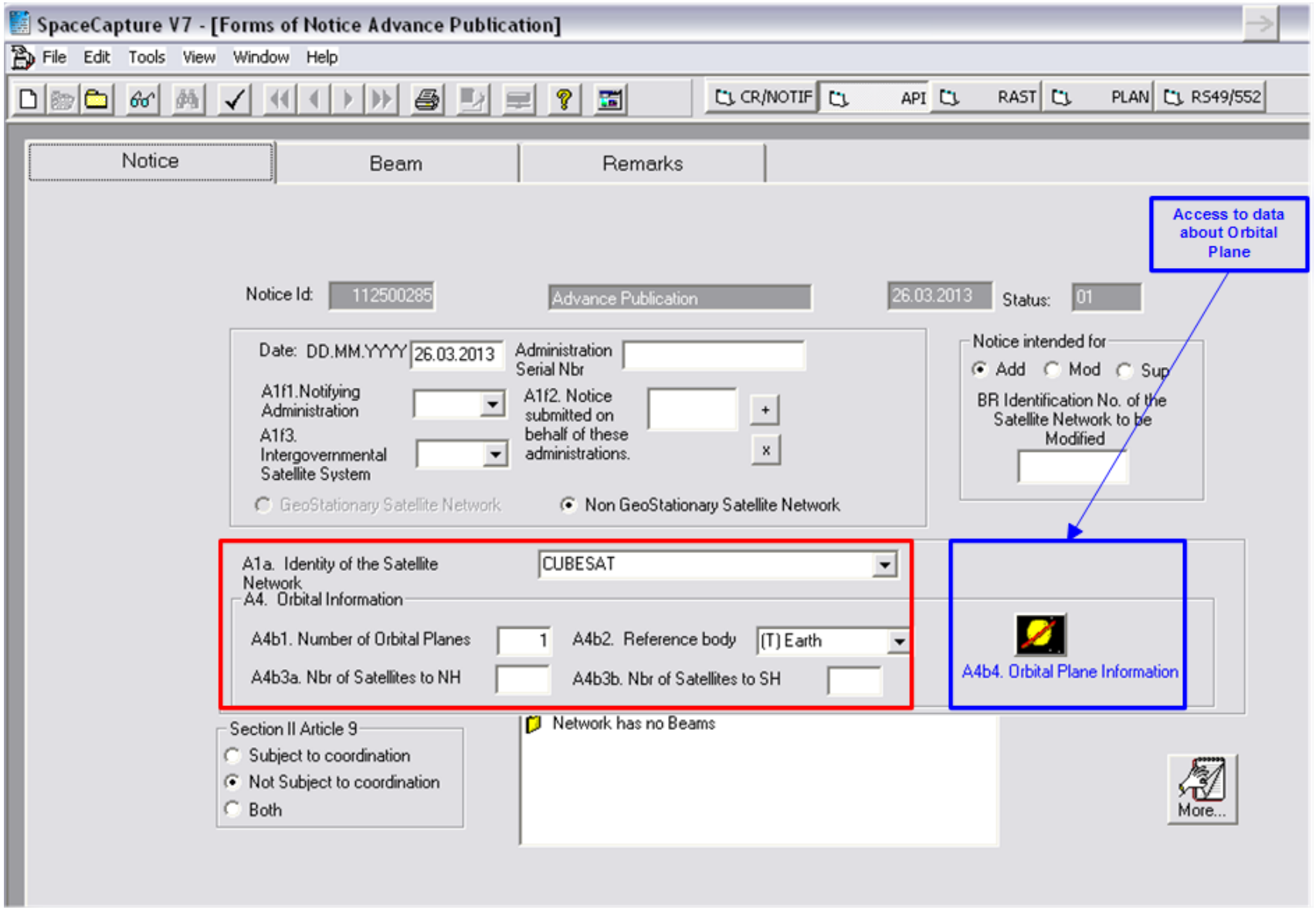
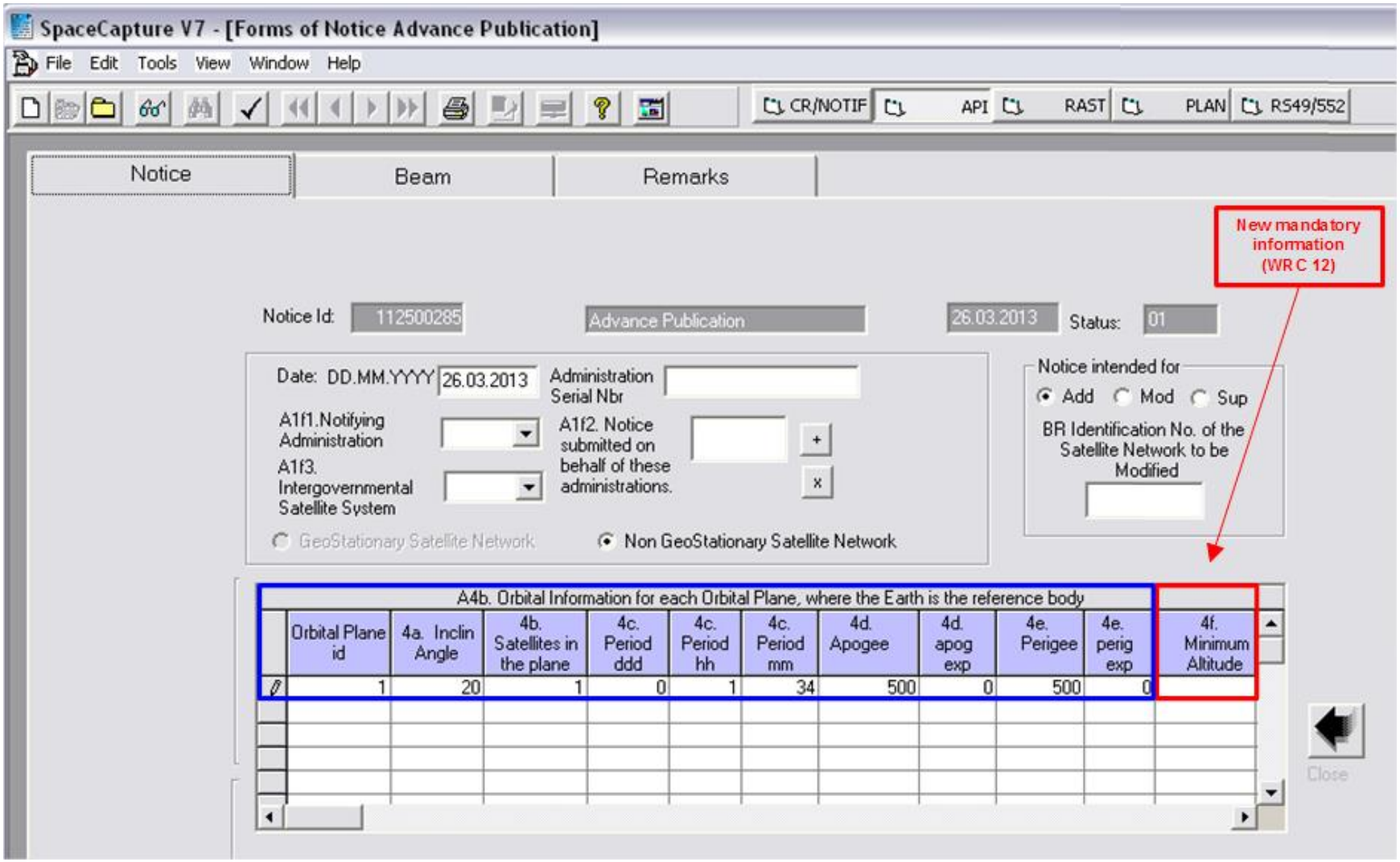
File Edit Tools View Window Help
CR/NOTIF API RAST PLAN RS49
Notice
Beam
Remarks
Notice Id: 4
Advance Publication
23.04.2009
Status: 01
Date: DD.MM.YYYY 23.04.2009
Administration Serial Nbr
A1f1.Notifying Administration
A1f2. Notice submitted on behalf of these administrations.
A1f3. Intergovernmental Satellite System
GeoStationary Satellite Network
Non GeoStationary Satellite Network
Notice intended for
Add Mod Sup
BR Identification No. of the Satellite Network to be Modified
Checking this box will give access to fields specific to non-geostationary stations
Section II Article 9
Subject to coordination
Not Subject to coordination
Both
Network has no Beams

API


SpaceCapture V7 - [Forms of Notice Advance Publication]
File Edit Tools View Window Help
CR/NOTIF API RAST PLAN RS49/552
Notice Beam Remarks
Access to data about Orbital Plane
Notice Id: 112500285
Advance Publication
26.03.2013
Status: 01
Date: DD.MM.YYYY 26.03.2013
Administration Serial Nbr
A1f1.Notifying Administration
A1f2. Notice submitted on behalf of these administrations.
A1f3. Intergovernmental Satellite System
Notice intended for
Add Mod Sup
BR Identification No. of the Satellite Network to be Modified
GeoStationary Satellite Network
Non GeoStationary Satellite Network
A1a. Identity of the Satellite Network
CUBESAT
A4. Orbital Information
A4b1. Number of Orbital Planes 1
A4b2. Reference body (T) Earth
A4b3a. Nbr of Satellites to NH
A4b3b. Nbr of Satellites to SH
A4b4. Orbital Plane Information
Section II Article 9
Subject to coordination
Not Subject to coordination
Both
Network has no Beams
More...

API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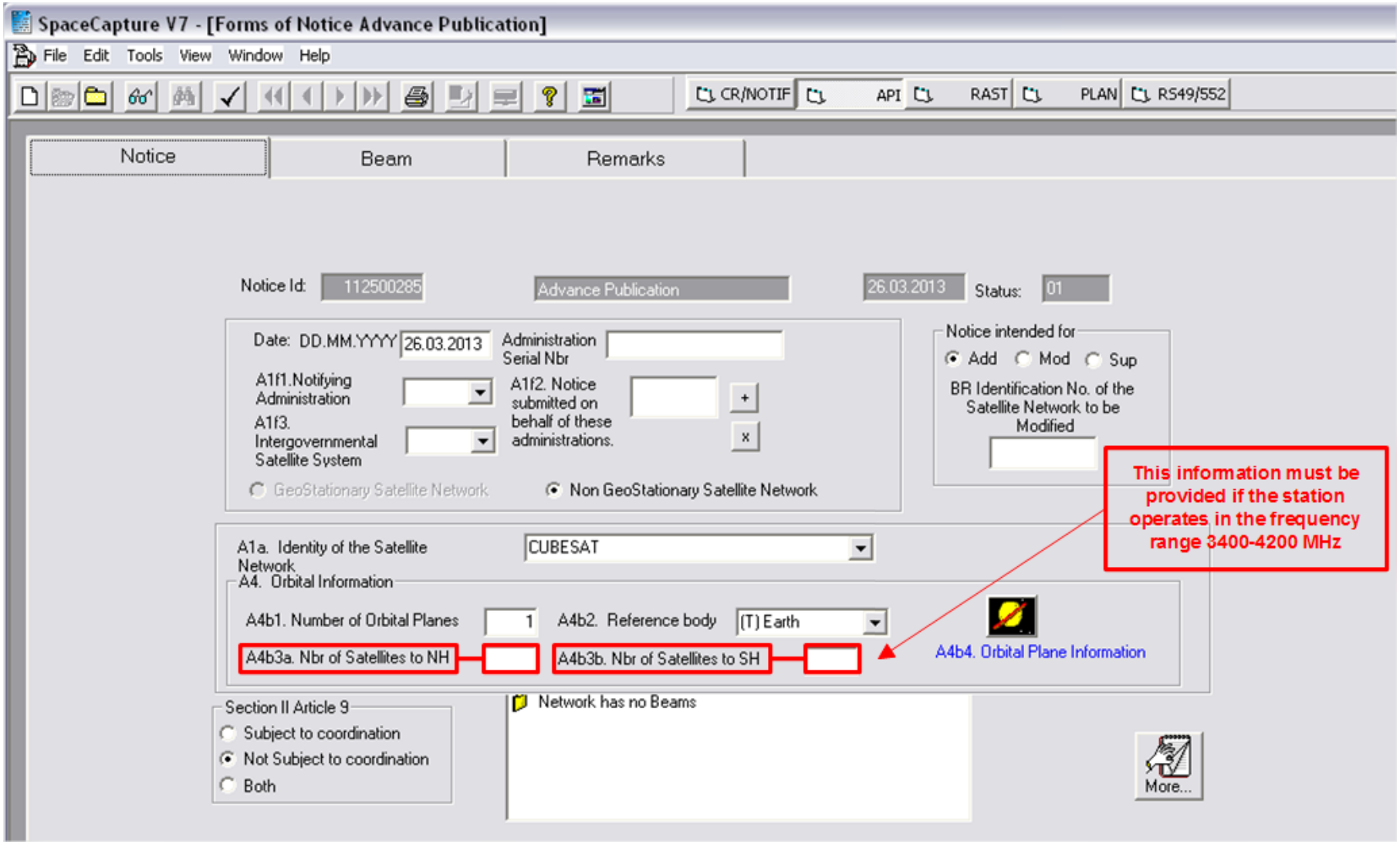
File Edit Tools View Window Help
CR/NOTIF API RAST PLAN RS49/552
Notice Beam Remarks
New mandatory information (WRC 12)
Notice Id: 112500285
Advance Publication
26.03.2013
Status: 01
Date: DD.MM.YYYY 26.03.2013
Administration Serial Nbr
A1f1.Notifying Administration
A1f2. Notice submitted on behalf of these administrations.
A1f3. Intergovernmental Satellite System
GeoStationary Satellite Network
Non GeoStationary Satellite Network
Notice intended for
Add Mod Sup
BR Identification No. of the Satellite Network to be Modified
A4b. Orbital Information for each Orbital Plane, where the Earth is the reference body
Orbital Plane id
4a. Inclin Angle
4b. Satellites in the plane
4c. Period ddd
4c. Period hh
4c. Period mm
4d. Apogee
4d. apog exp
4e. Perigee
4e. perig exp
4f. Minimum Altitude
1 20 1 0 1 34 500 0 500 0
Close

API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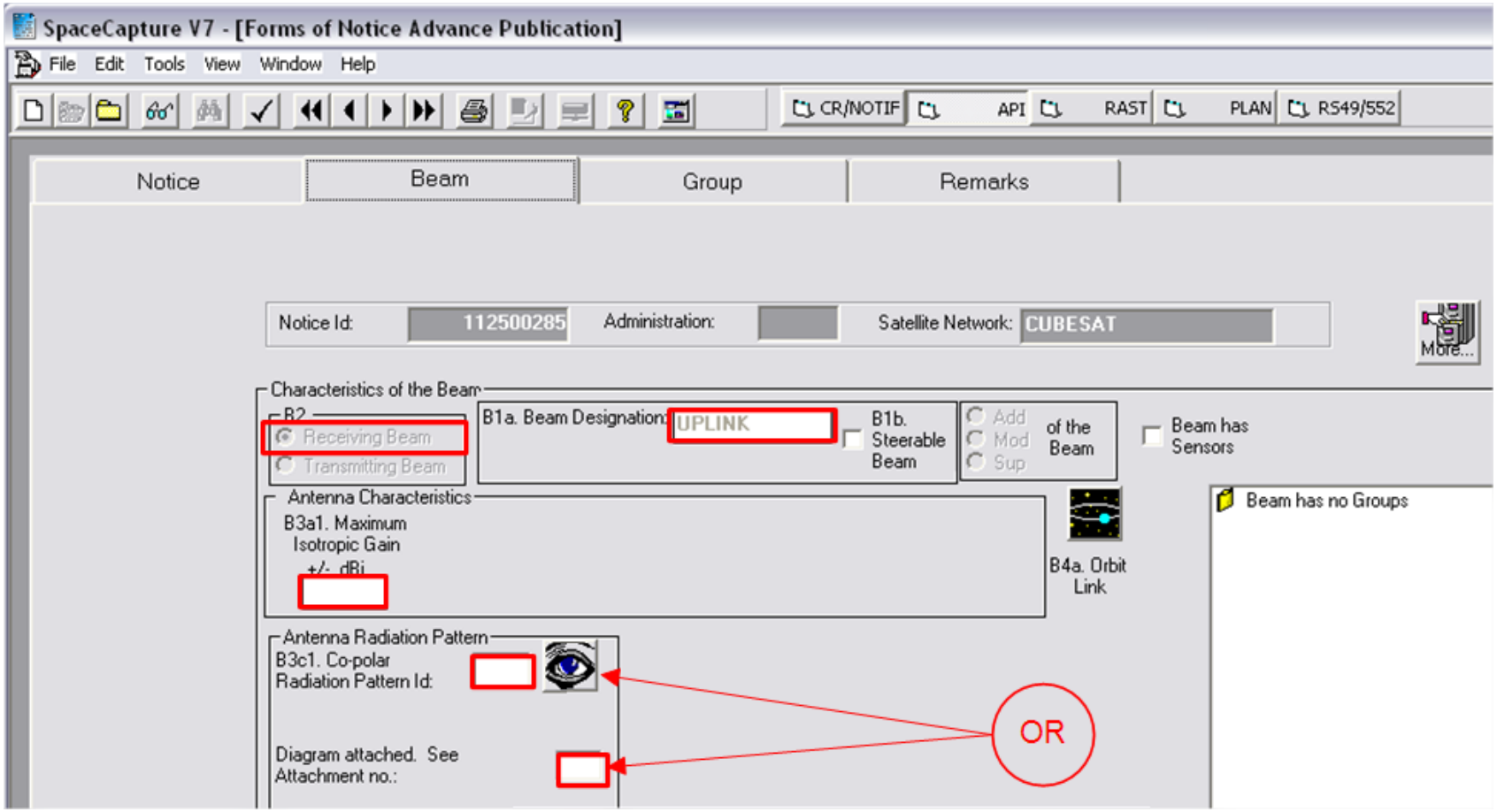
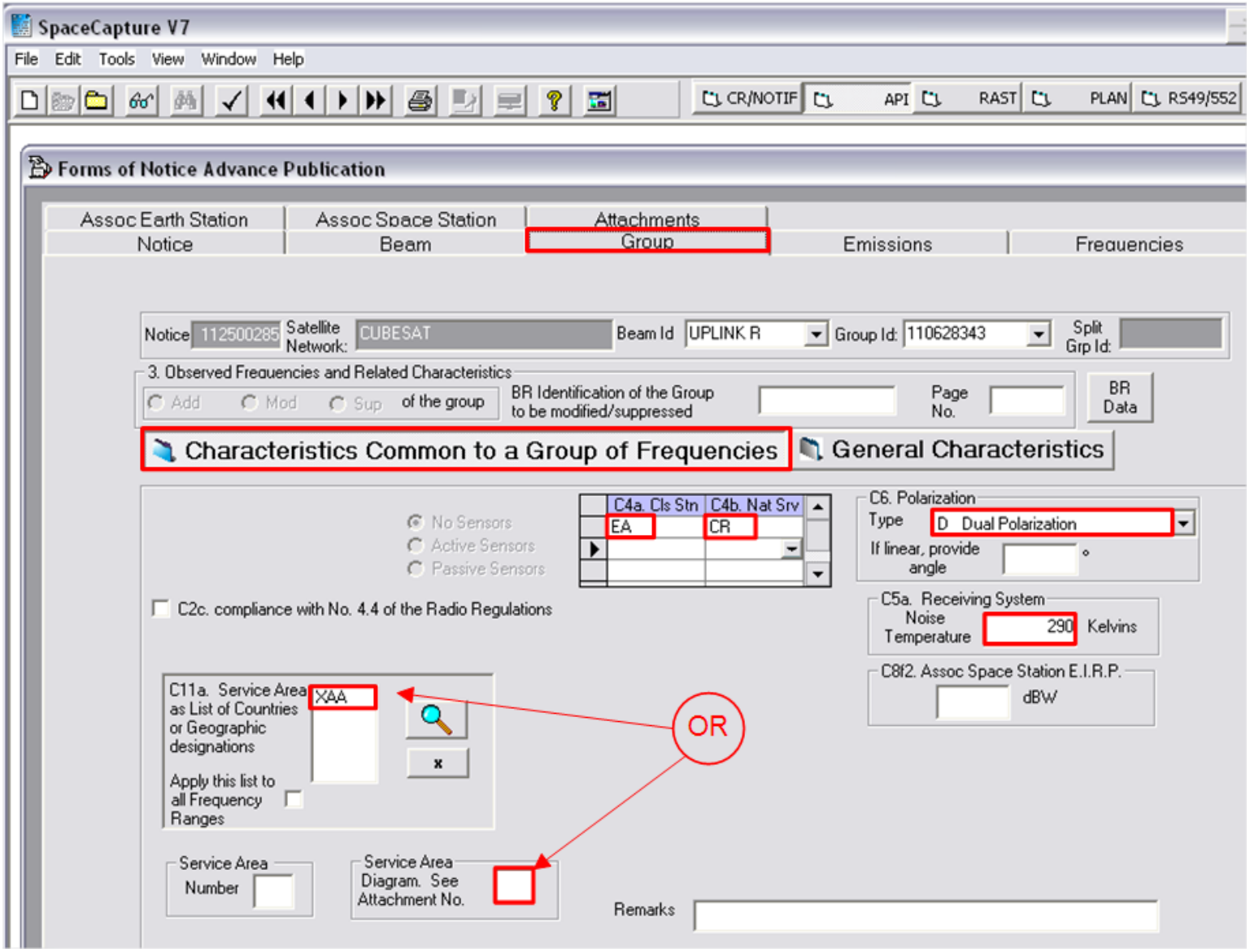
File Edit Tools View Window Help
CR/NOTIF API RAST PLAN RS49/552
Notice
Beam
Remarks
Notice Id: 112500285
Advance Publication
26.03.2013
Status: 01
Date: DD.MM.YYYY 26.03.2013
Administration Serial Nbr
A1f1.Notifying Administration
A1f2. Notice submitted on behalf of these administrations.
A1f3. Intergovernmental Satellite System
GeoStationary Satellite Network
Non GeoStationary Satellite Network
Notice intended for
Add Mod Sup
BR Identification No. of the Satellite Network to be Modified
This information must be provided if the station operates in the frequency range 3400-4200 MHz
A1a. Identity of the Satellite Network
CUBESAT
A4. Orbital Information
A4b1. Number of Orbital Planes 1
A4b2. Reference body (T) Earth
A4b3a. Nbr of Satellites to NH
A4b3b. Nbr of Satellites to SH
A4b4. Orbital Plane Information
Section II Article 9
Subject to coordination
Not Subject to coordination
Both
Network has no Beams
More...

API CAPTURE RECEIVING BEAM INFORMATION

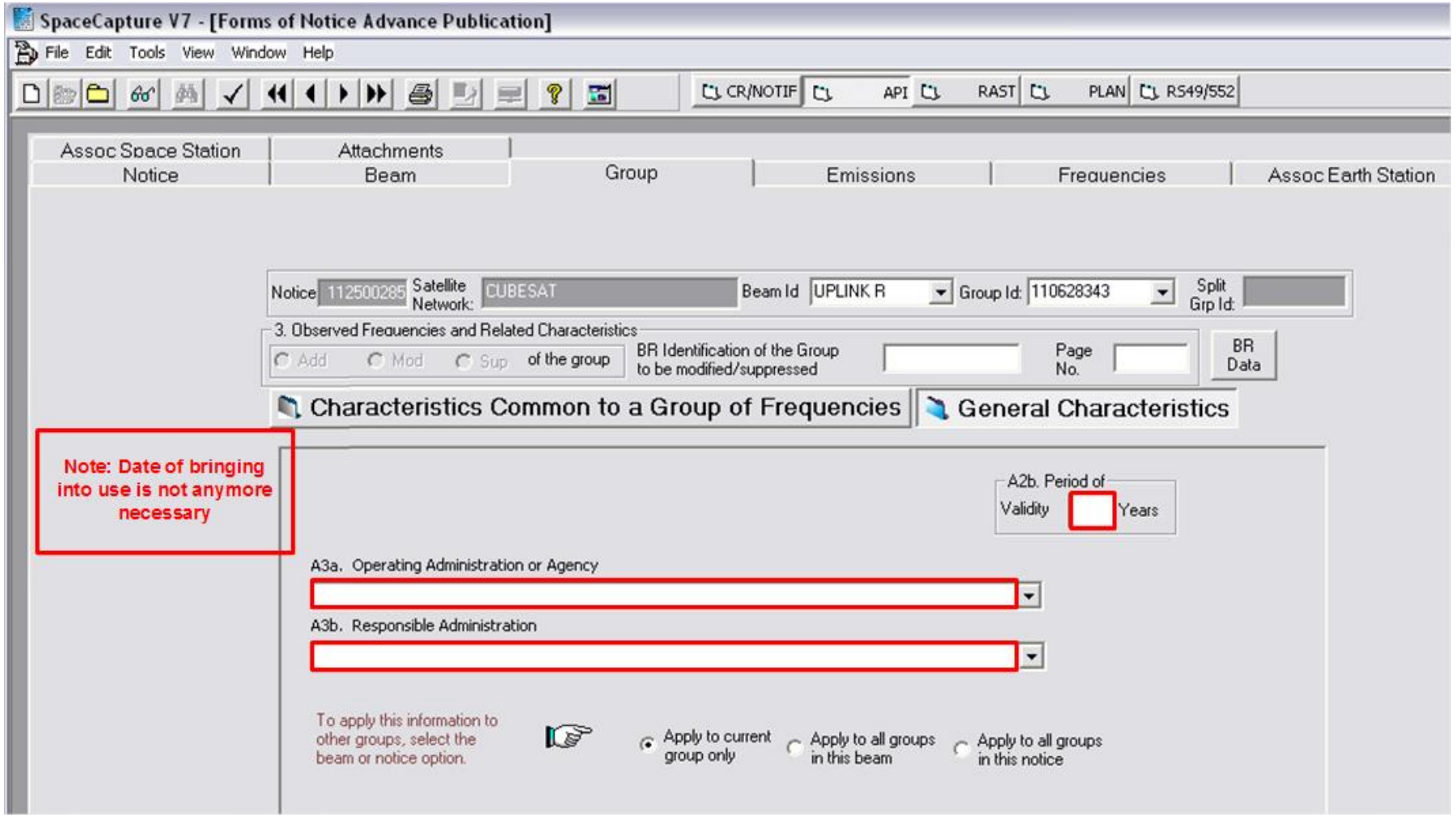


API CAPTURE GROUP INFORMATION

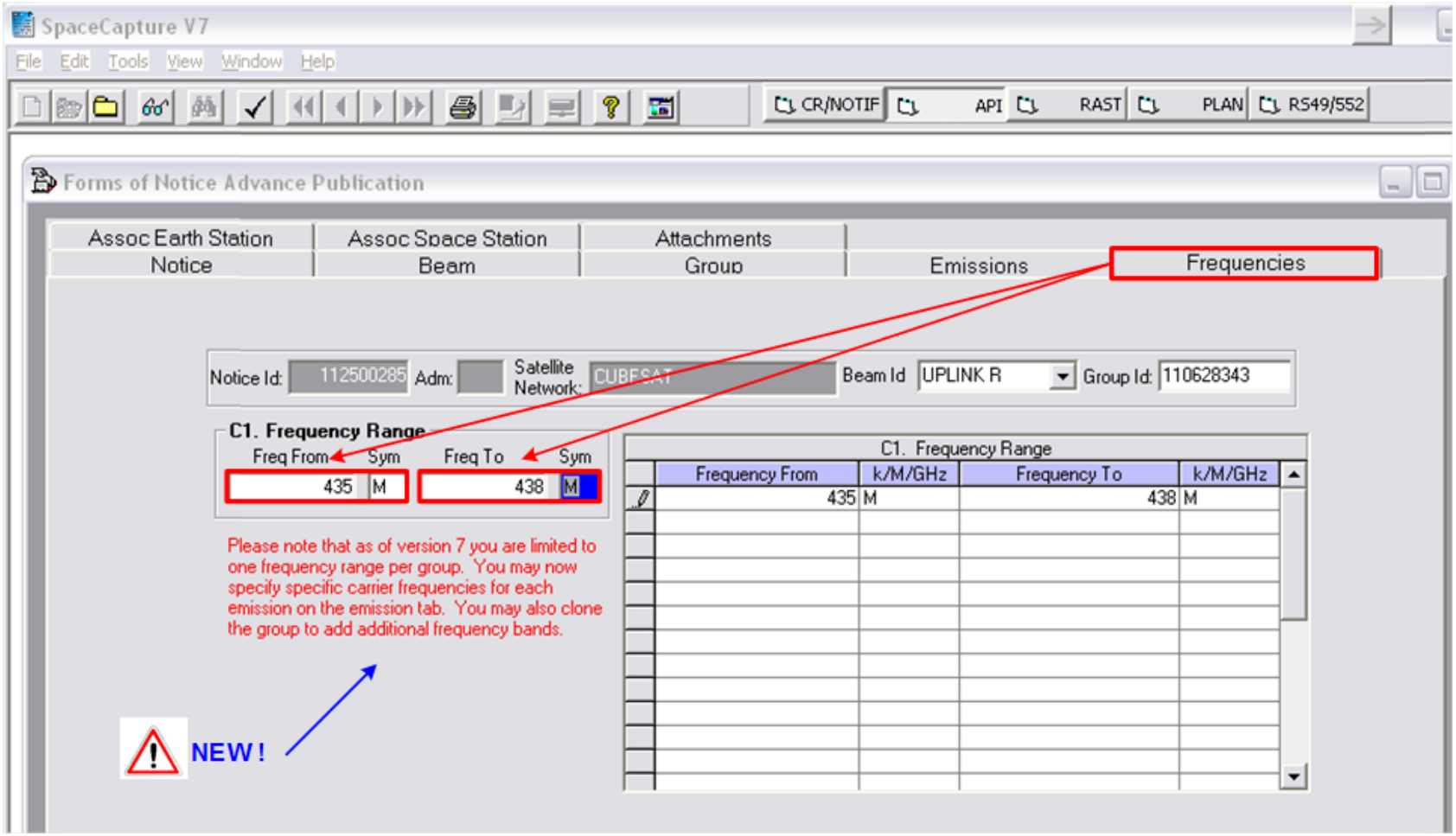
COMMON CHARACTERISTICS



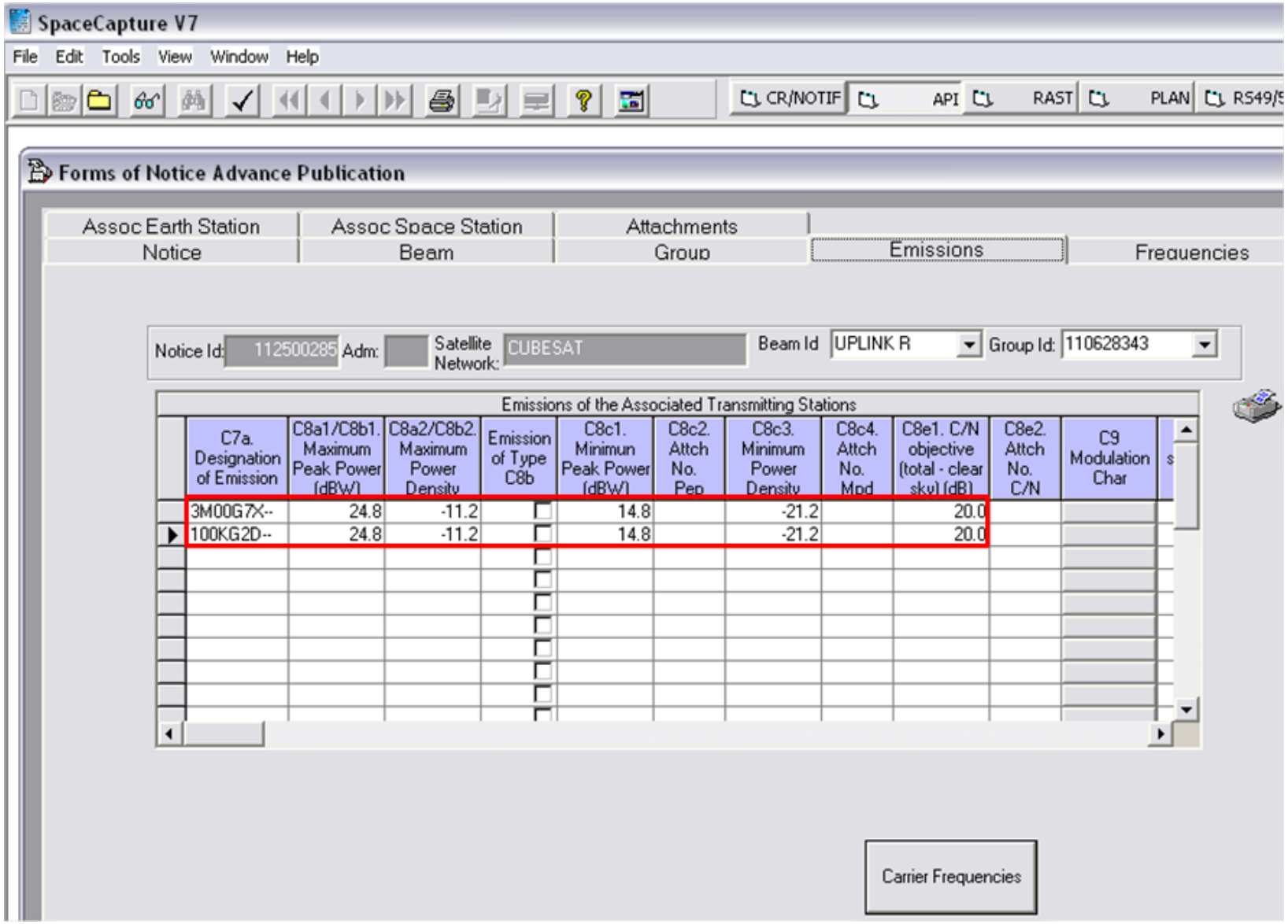
API GENERAL CHARACTERISTICS



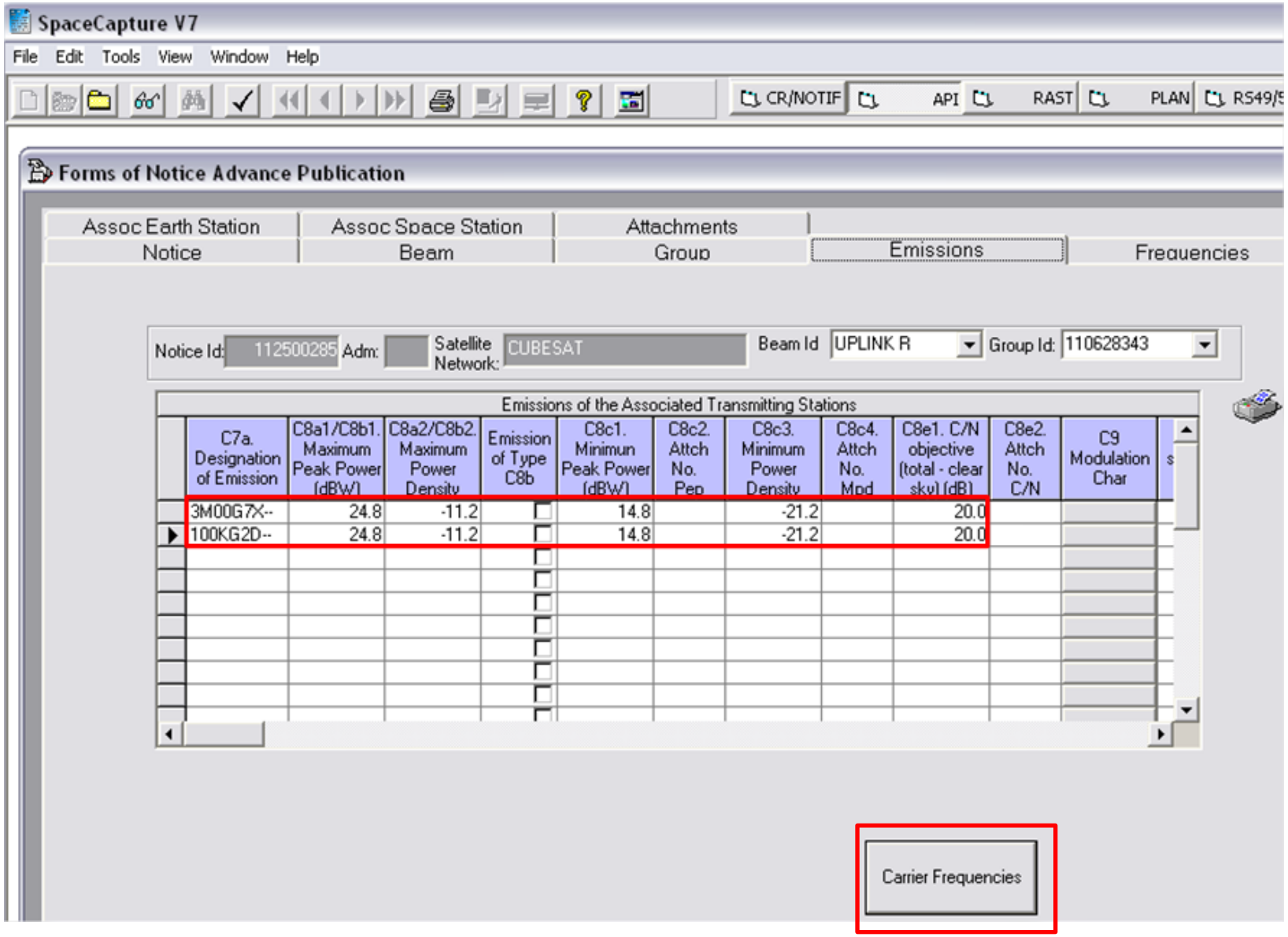
API FREQUENCY RANGES



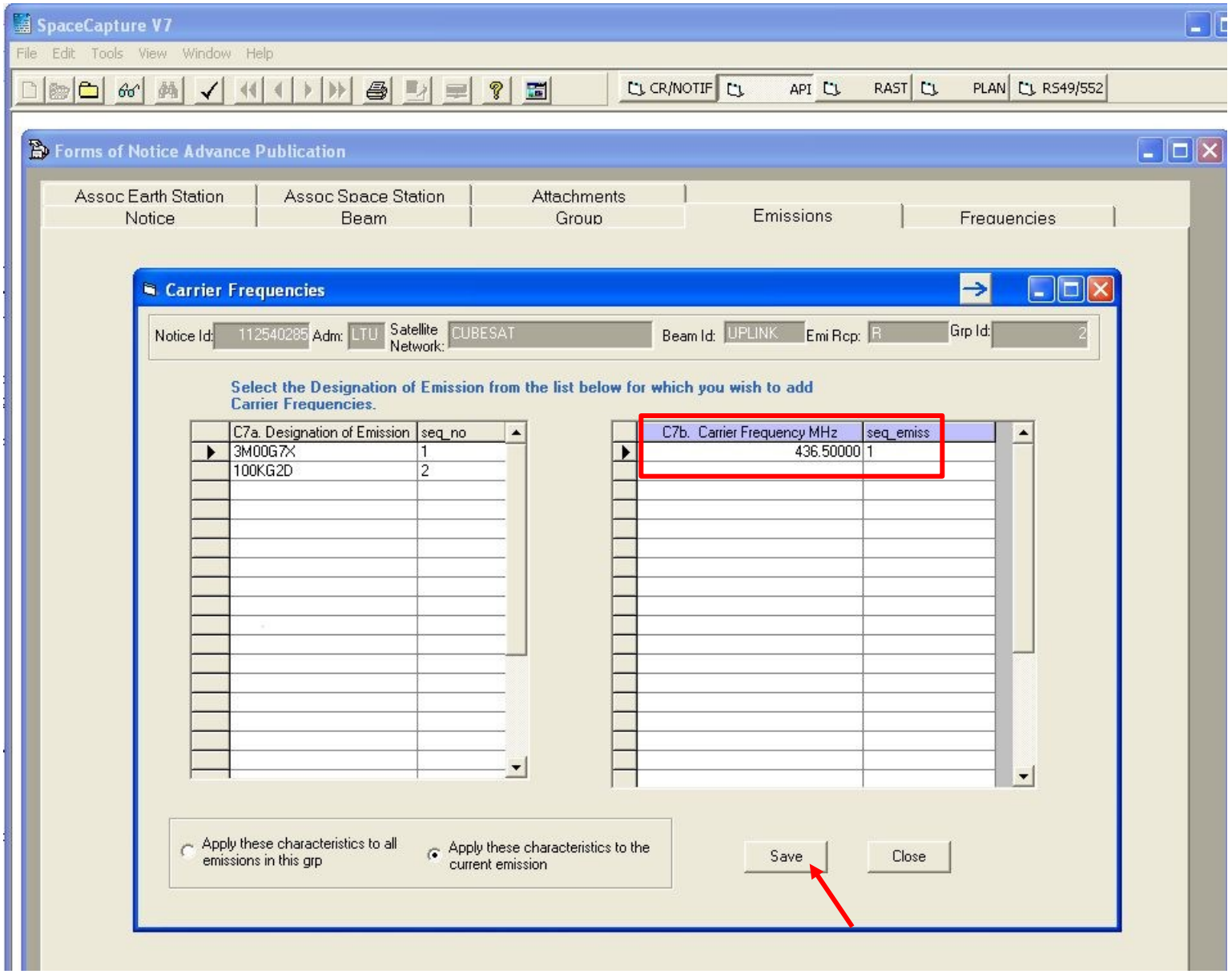
API EMISSIONS



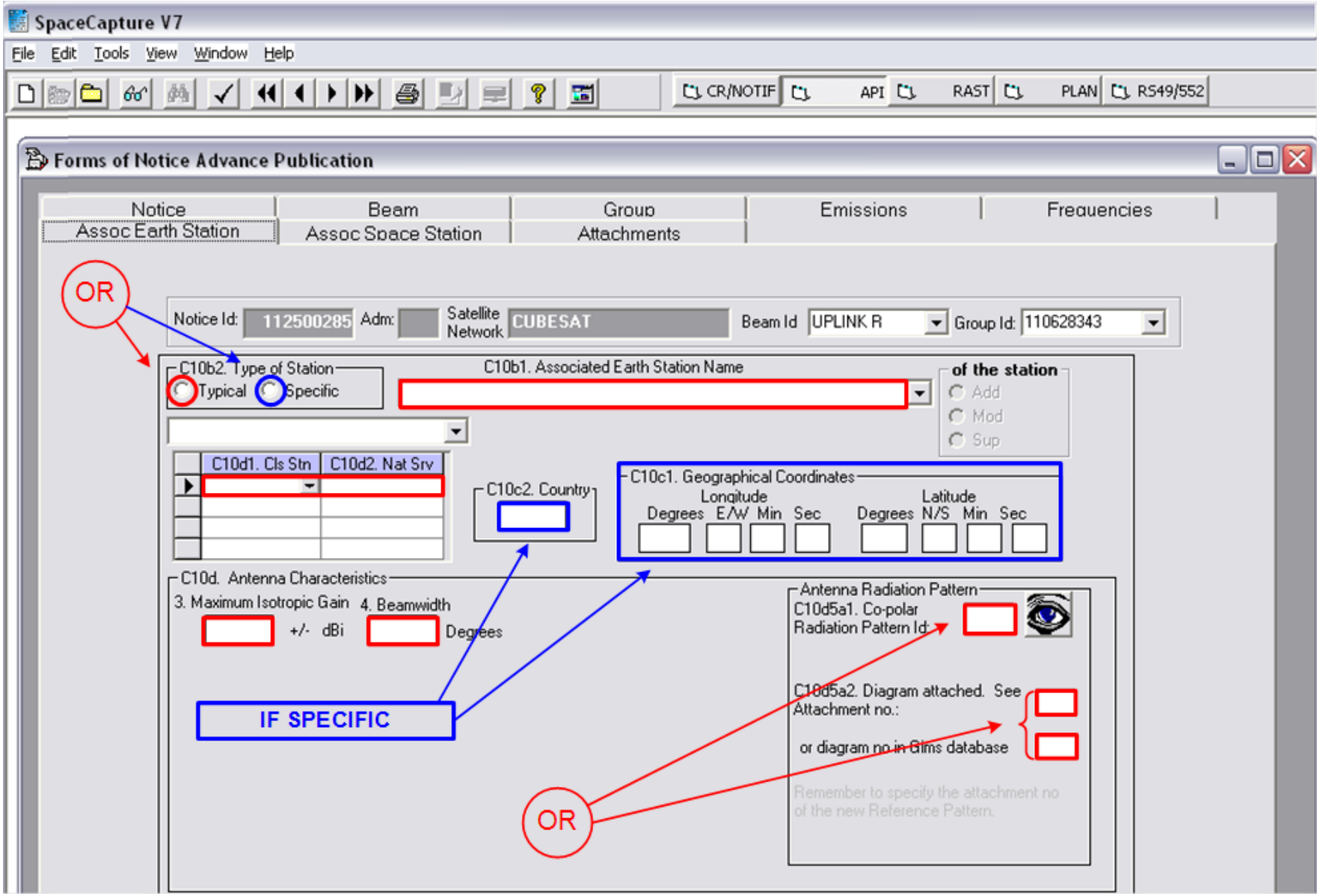
EMISSIONS


SpaceCapture V7
File Edit Tools View Window Help
CR/NOTIF API RAST PLAN RS49/S
Forms of Notice Advance Publication
Assoc Earth Station
Assoc Space Station
Attachments
Notice
Beam
Group
Emissions
Frequencies
Notice Id: 112500285 Adm: Satellite Network: CUBESAT
Beam Id UPLINK R
Group Id: 110628343
Emissions of the Associated Transmitting Stations
C7a. Designation of Emission
C8a1/C8b1. Maximum Peak Power (dBW)
C8a2/C8b2. Maximum Power Density
Emission of Type C8b
C8c1. Minimun Peak Power (dBW)
C8c2. Attch No. Pep
C8c3. Minimum Power Density
C8c4. Attch No. Mod
C8e1. C/N objective (total - clear sky) (dB)
C8e2. Attch No. C/N
C9 Modulation Char
3M00G7X-- 24.8 -11.2 14.8 -21.2 20.0
100KG2D-- 24.8 -11.2 14.8 -21.2 20.0
Carrier Frequencies

EMISSIONS - Carrier Frequencies



API ASSOCIATED EARTH STATION



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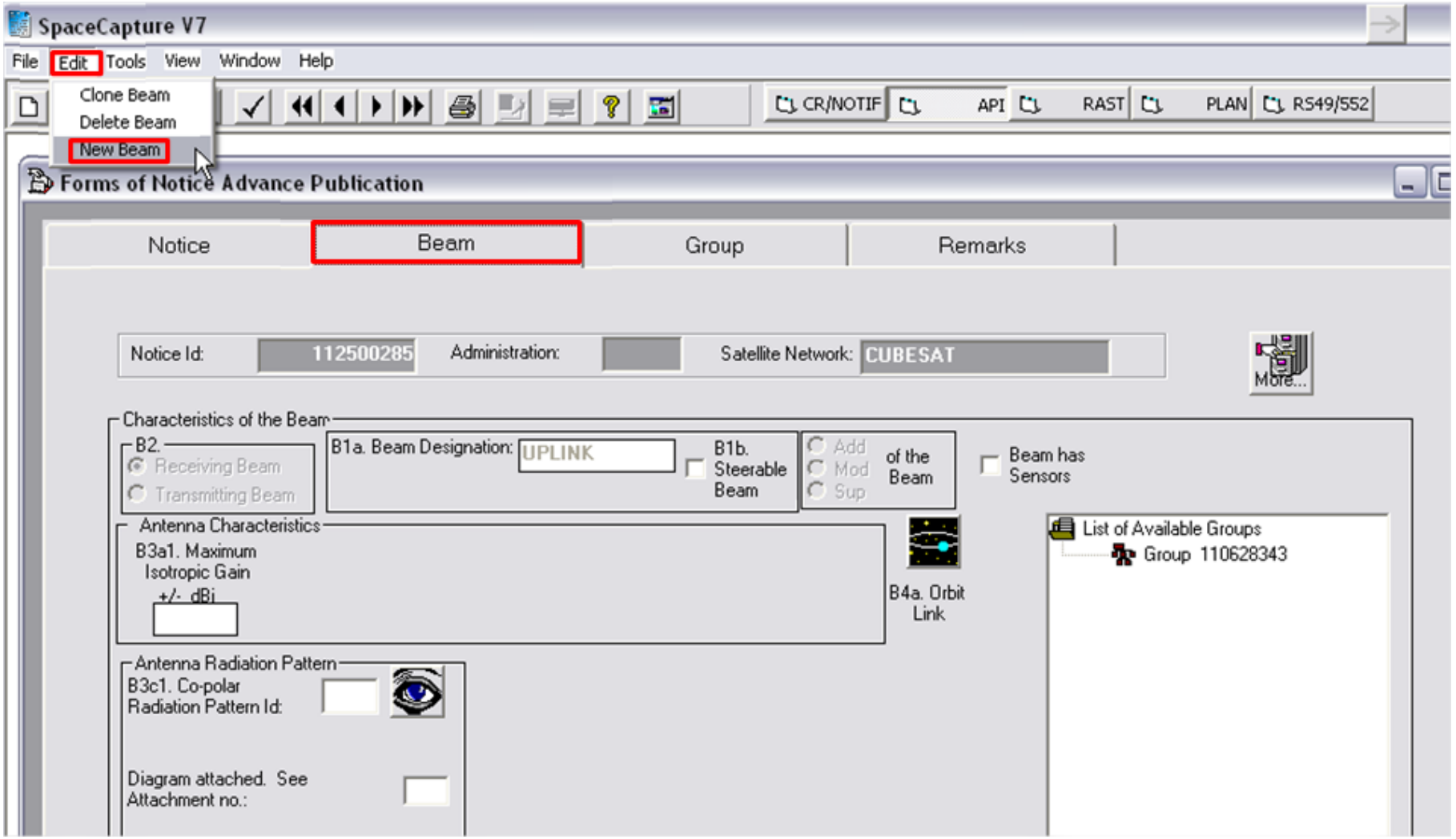
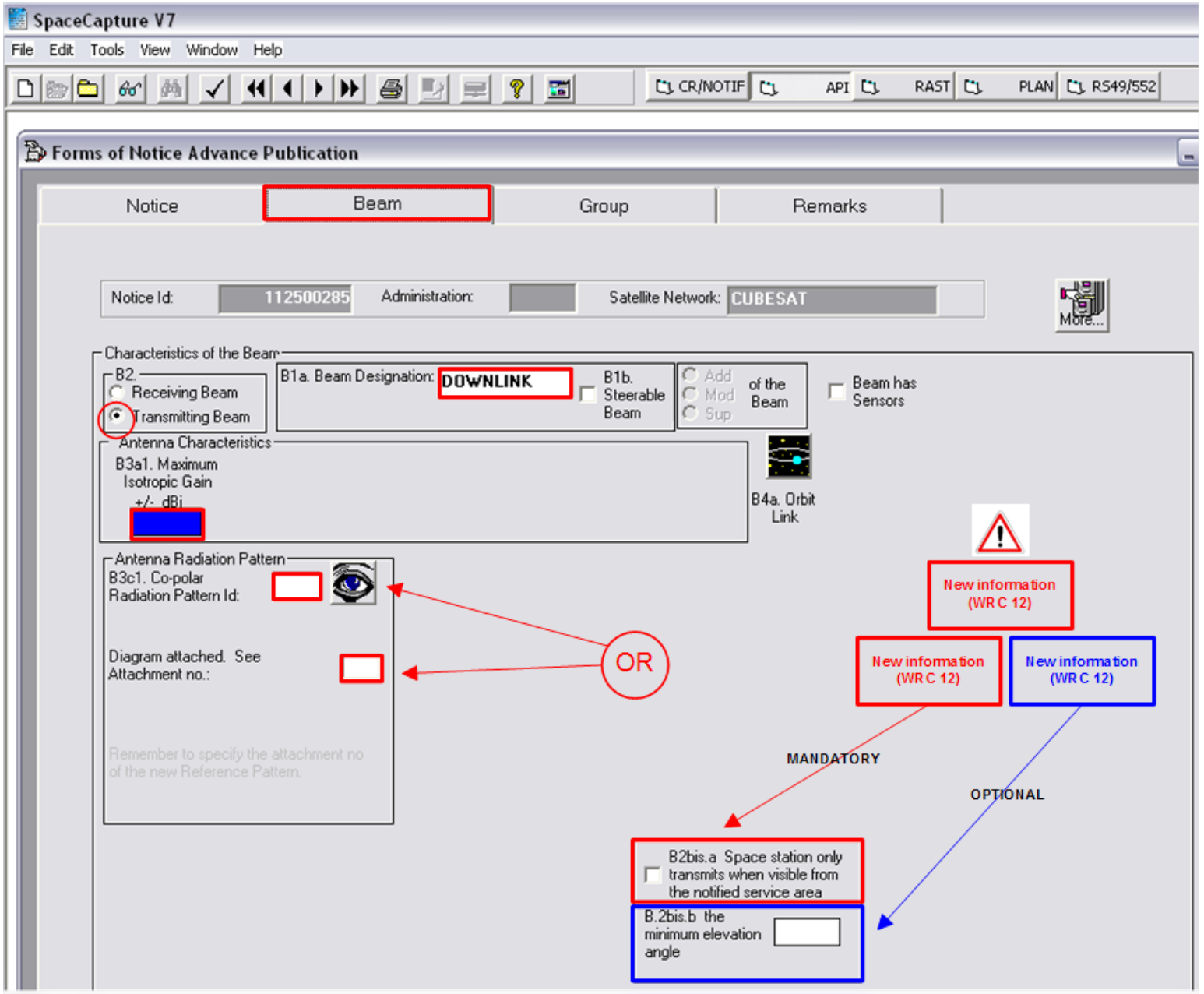
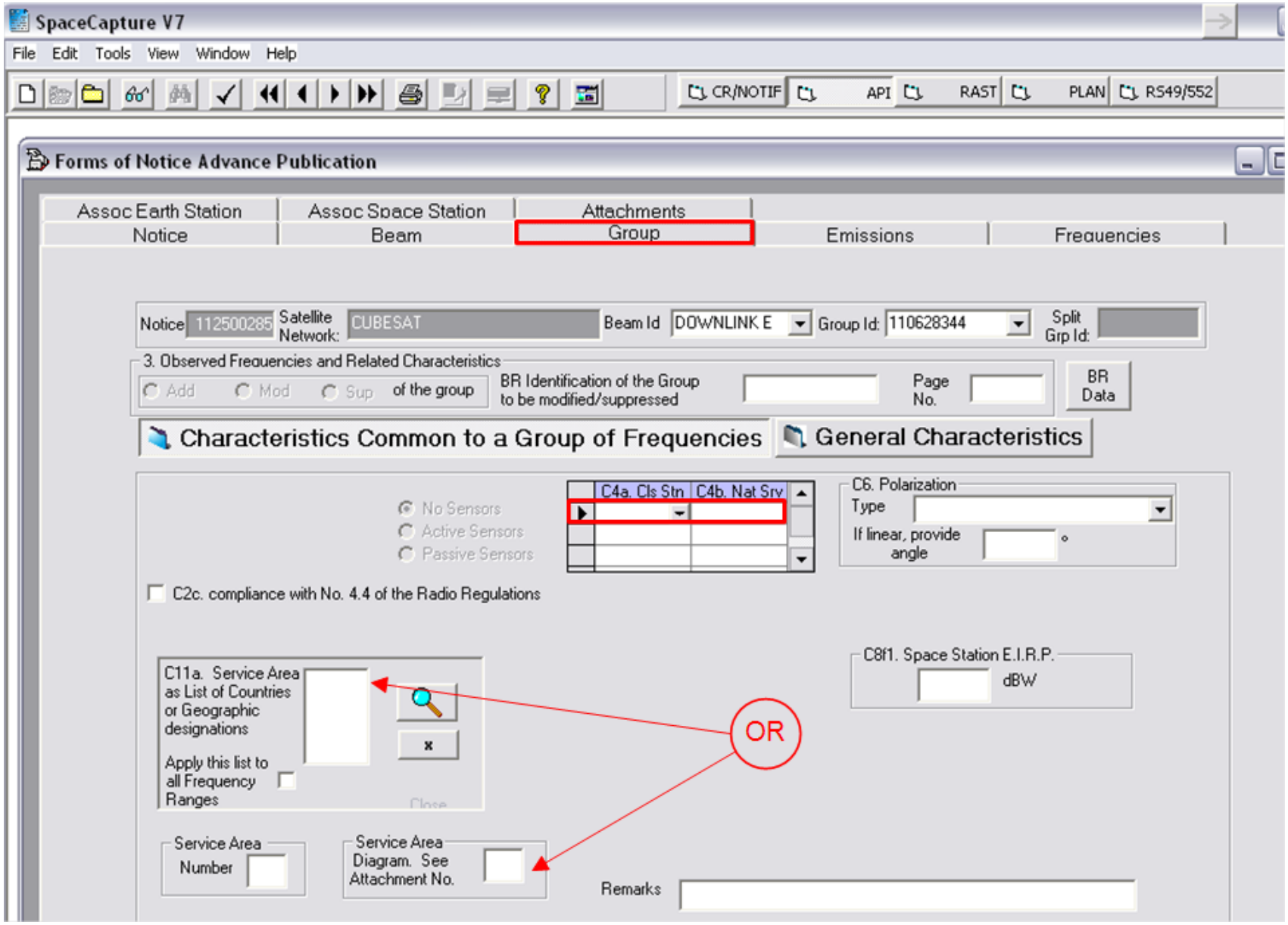


API

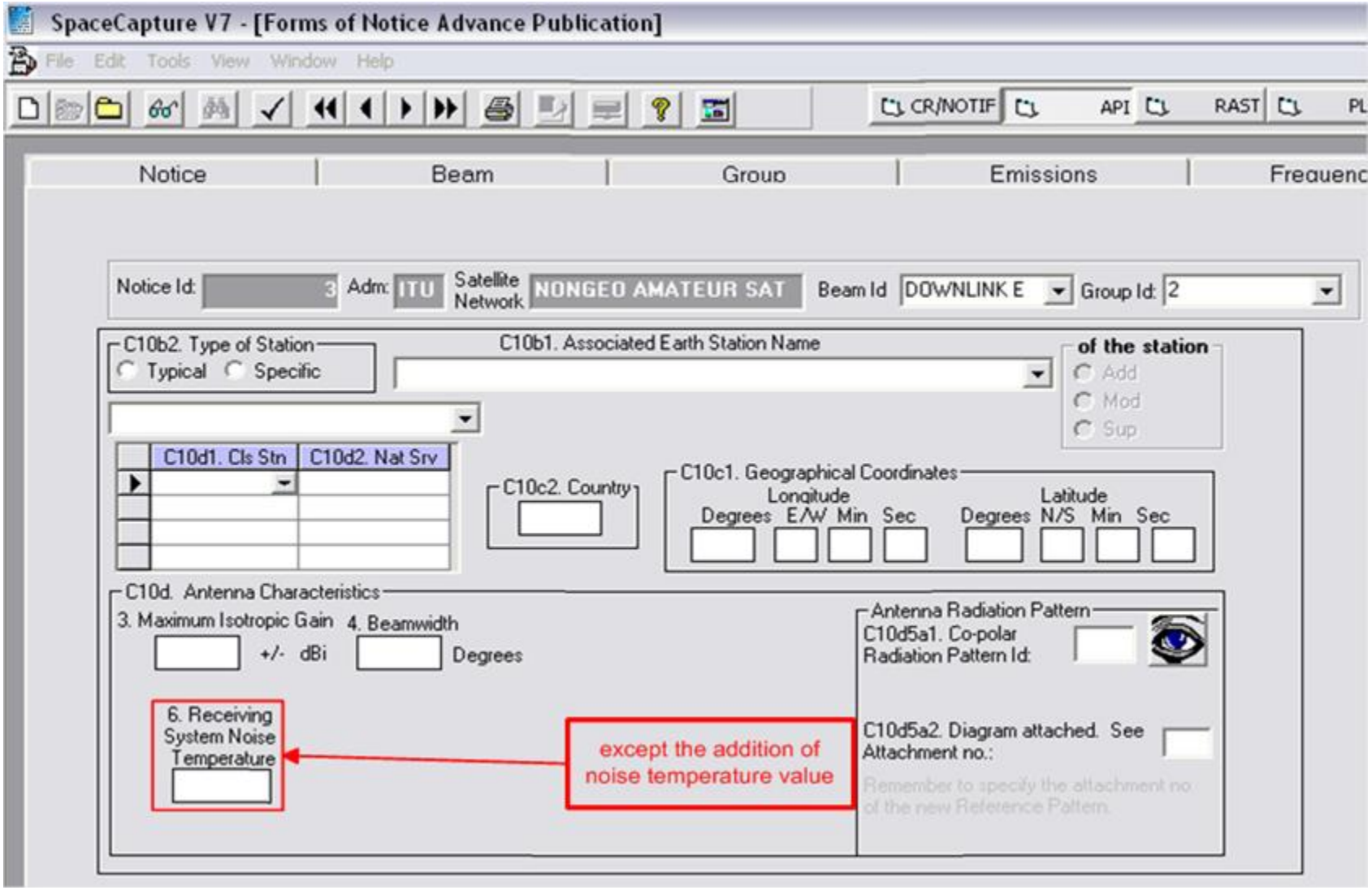

SpaceCapture V7
File Edit Tools View Window Help
CR/NOTIF API RAST PLAN RS49/552
Forms of Notice Advance Publication
Notice Beam Group Remarks
Notice Id: 112500285 Administration: Satellite Network: CUBESAT
More...
Characteristics of the Beam
B2.
Receiving Beam
Transmitting Beam
B1a. Beam Designation: DOWNLINK
B1b. Steerable Beam
Add Mod Sup of the Beam
Beam has Sensors
Antenna Characteristics
B3a1. Maximum Isotropic Gain
+/- dBi
B4a. Orbit Link
Antenna Radiation Pattern
B3c1. Co-polar Radiation Pattern Id:
Diagram attached. See Attachment no.:
Remember to specify the attachment no of the new Reference Pattern.
OR
New information (WRC 12)
New information (WRC 12)
New information (WRC 12)
MANDATORY
OPTIONAL
B2bis.a Space station only transmits when visible from the notified service area
B.2bis.b the minimum elevation angle

API

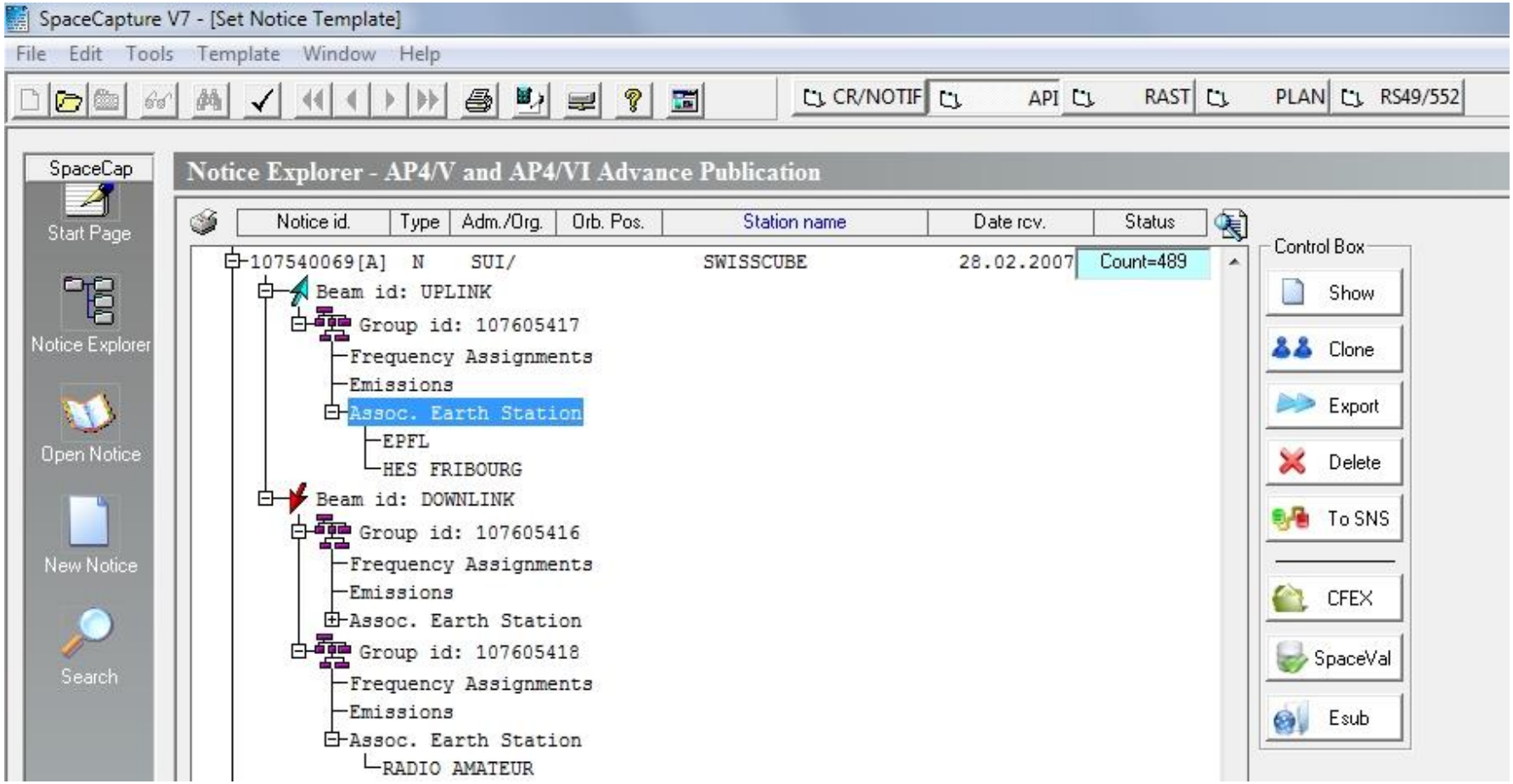

SpaceCapture V7
File Edit Tools View Window Help
CR/NOTIF API RAST PLAN RS49/552
Forms of Notice Advance Publication
Assoc Earth Station Notice
Assoc Space Station Beam
Attachments Group
Emissions
Frequencies
Notice 112500285 Satellite Network: CUBESAT
Beam Id DOWNLINK E
Group Id: 110628344
Split Grp Id:
3. Observed Frequencies and Related Characteristics
Add Mod Sup of the group
BR Identification of the Group to be modified/suppressed
Page No.
BR Data
Characteristics Common to a Group of Frequencies
General Characteristics
No Sensors
Active Sensors
Passive Sensors
C4a. Cls Stn
C4b. Nat Srv
C6. Polarization
Type
If linear, provide angle
C2c. compliance with No. 4.4 of the Radio Regulations
C11a. Service Area as List of Countries or Geographic designations
Apply this list to all Frequency Ranges
Close
OR
C8f1. Space Station E.I.R.P.
dBW
Service Area Number
Service Area Diagram. See Attachment No.
Remarks

EMISSION AND FREQUENCY SCREENS ARE IDENTICAL FOR RECEIVING AND TRANSMITTING BEAMS

API ASSOCIATED EARTH STATION SCREEN IS ALMOST IDENTICAL IN RECEPTION AND EMISSION



API - CAPTURE IS DONE !

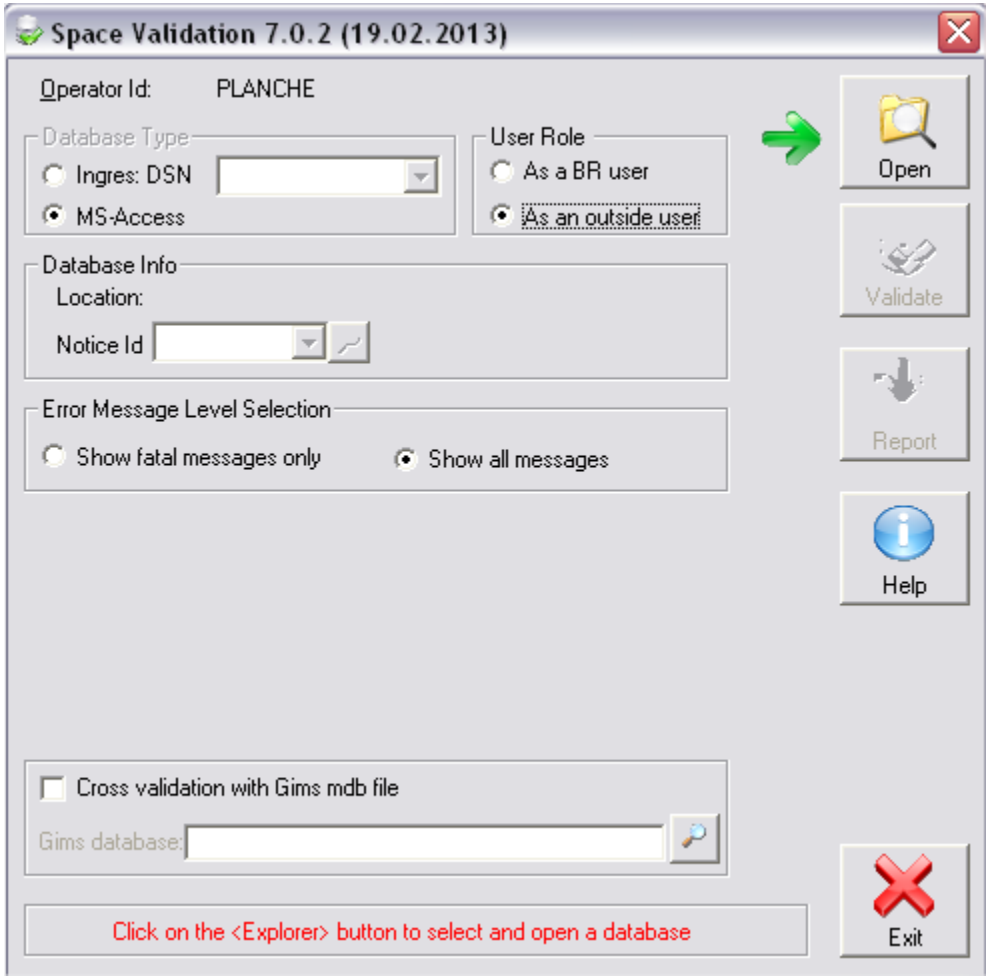


Use the Bureau **SpaceValidation** programme for a

MANDATORY CHECK OF THE DATA CAPTURE RESULT

Verify if you have the latest version of SpaceVal

http://www.itu.int/ITU-R/go/space-software/en

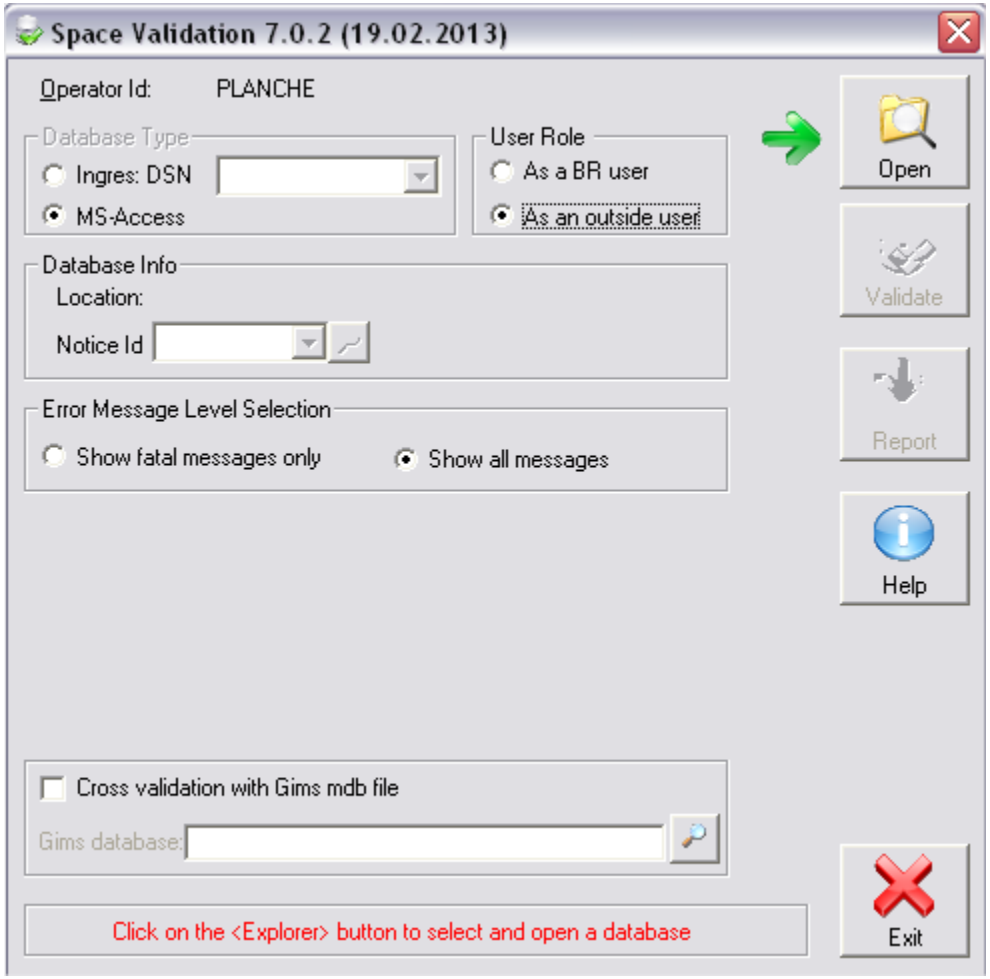


Use the Bureau **SpaceValidation** programme for a

MANDATORY CHECK OF THE DATA CAPTURE RESULT

Verify if you have the latest version of SpaceVal

http://www.itu.int/ITU-R/go/space-software/en

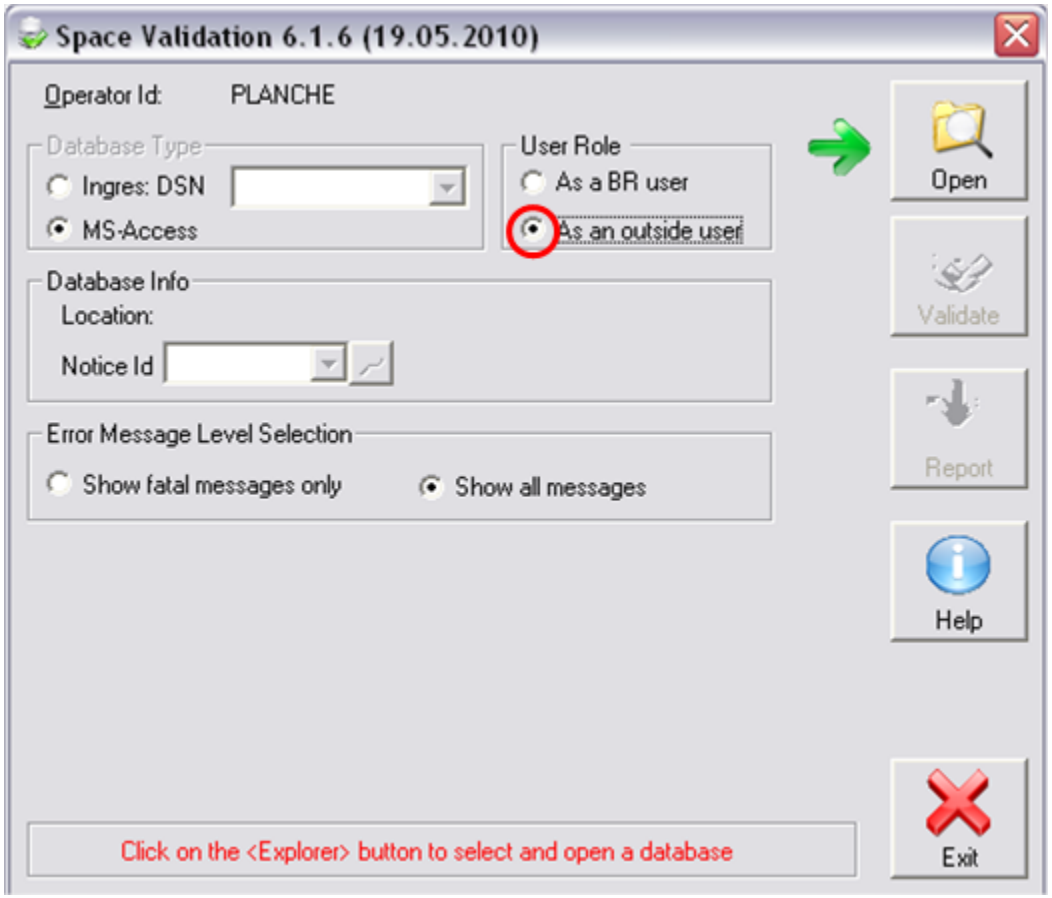


Use the Bureau **SpaceValidation** programme for a ***MANDATORY CHECK OF THE DATA CAPTURE RESULT***

Verify if you have the latest version of SpaceVal

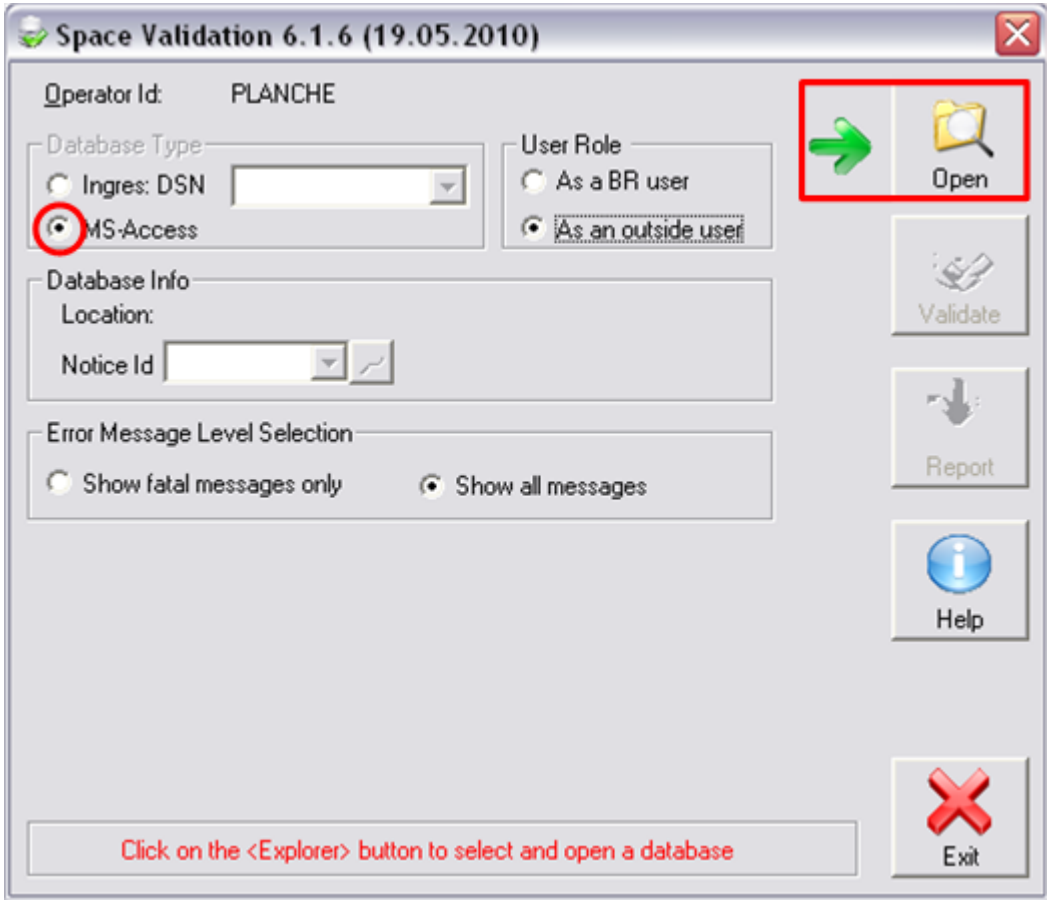
http://www.itu.int/ITU-R/go/space-software/en

STEP 1

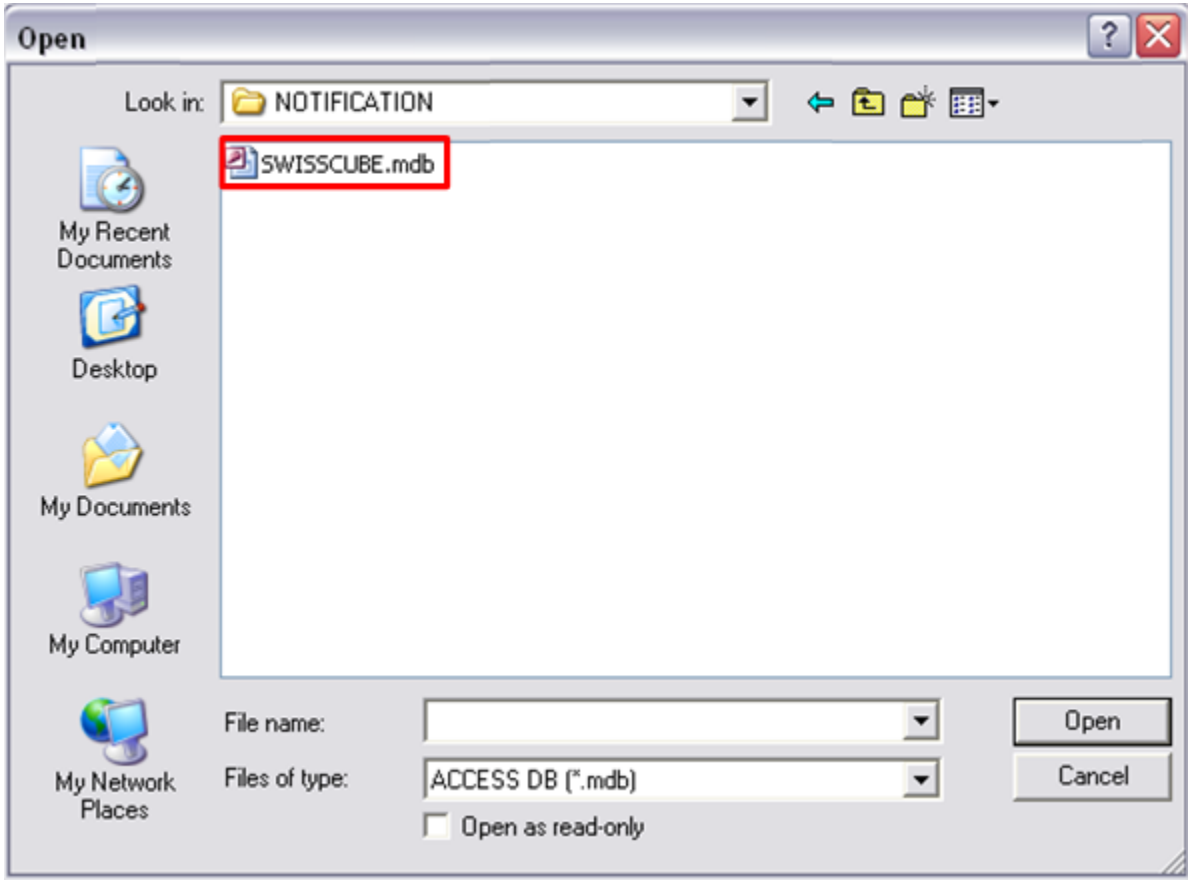


SELECT YOUR ACCESS DATABASE

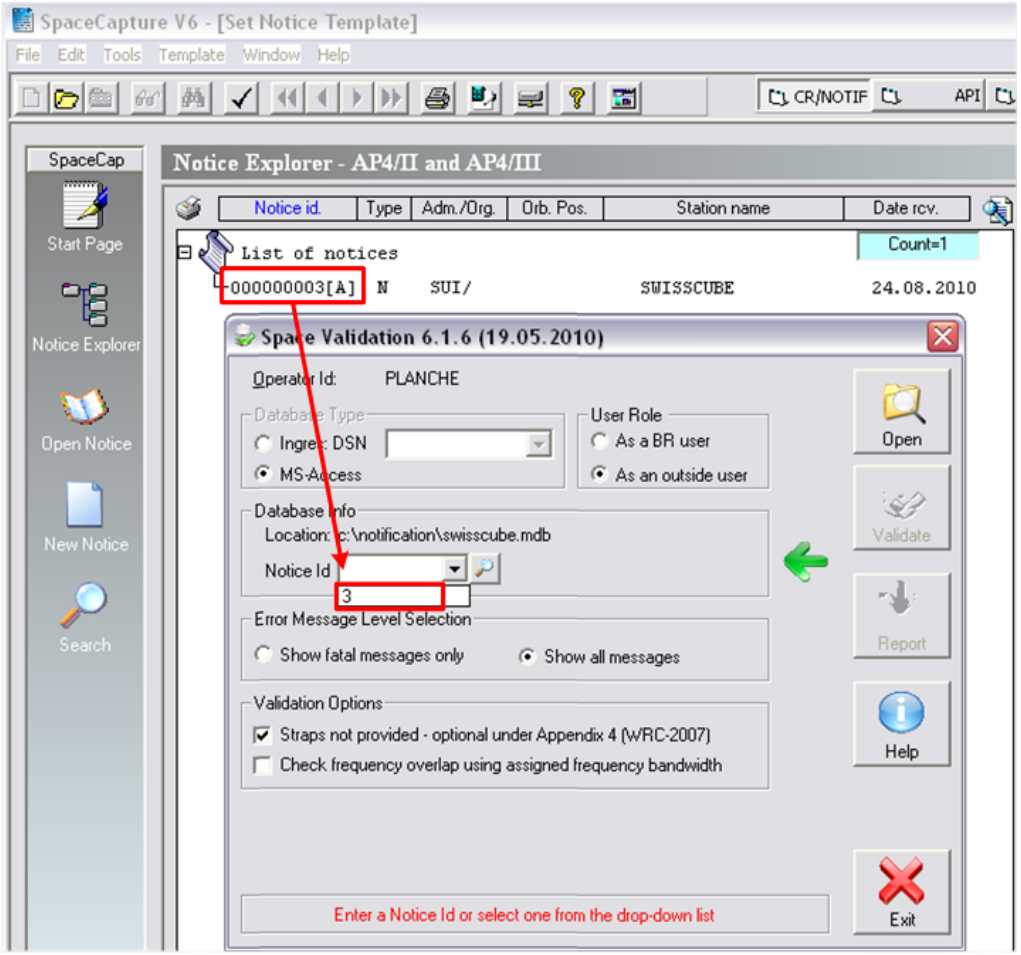
STEP 2



SELECT ON YOUR HARD DISK
THE FILE CONTAINING YOUR CAPTURE

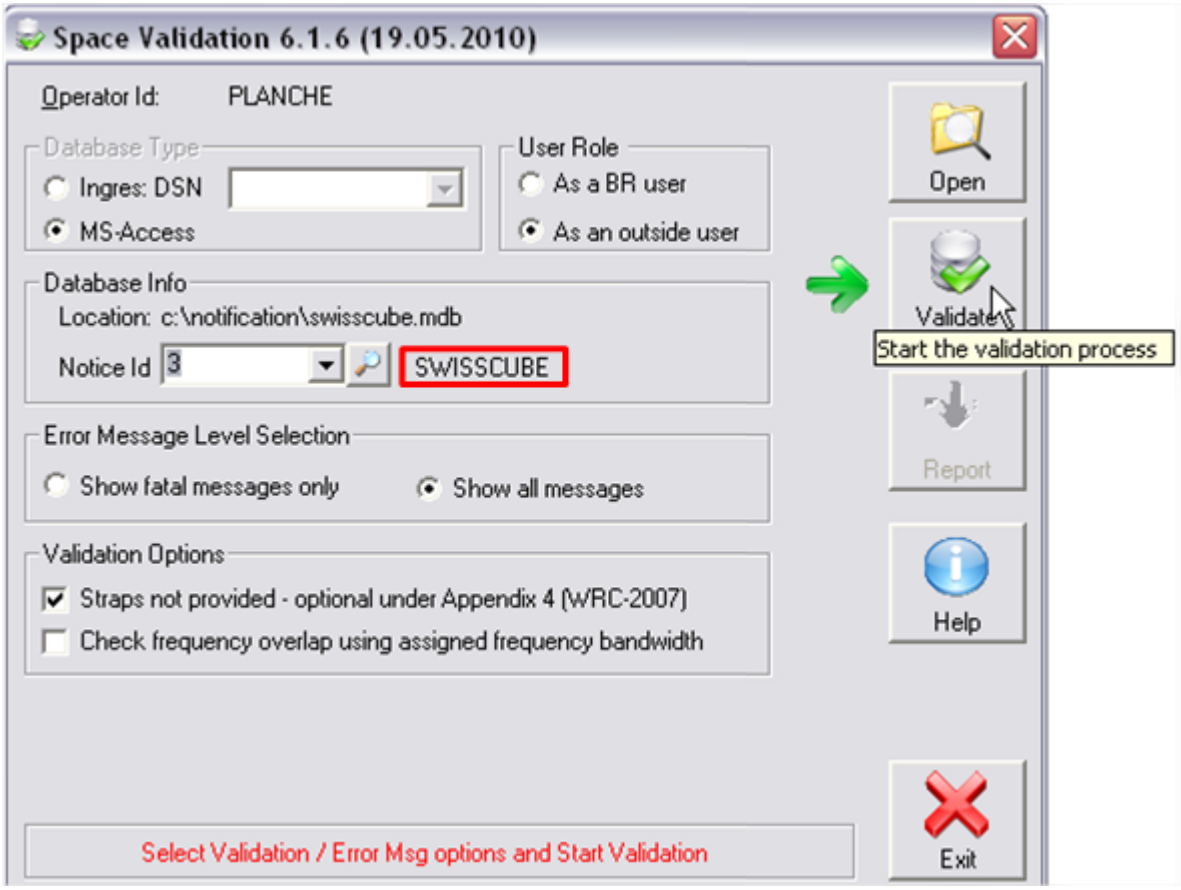


CONFIRM YOUR SELECTION



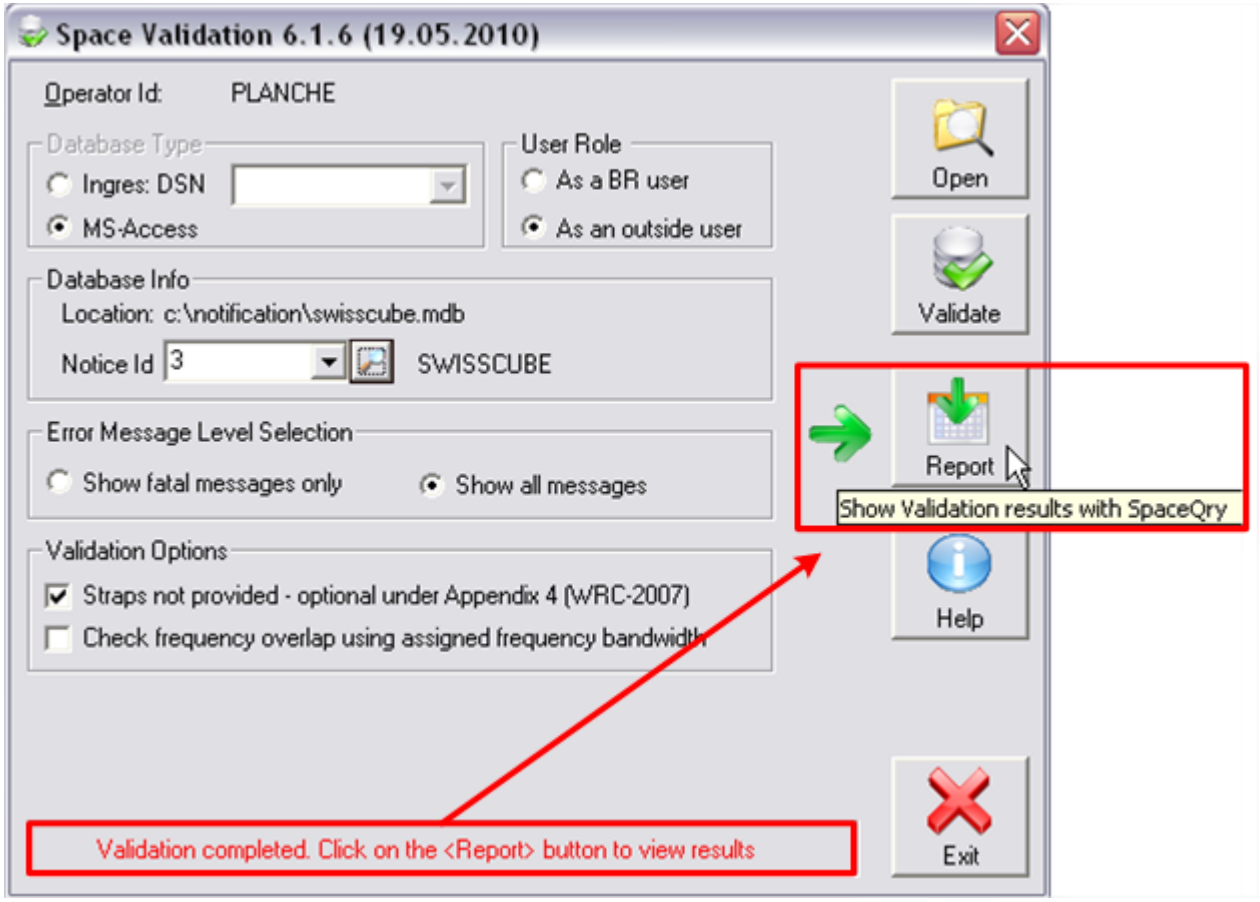
LAUNCH THE VALIDATION PROCESS

STEP 3

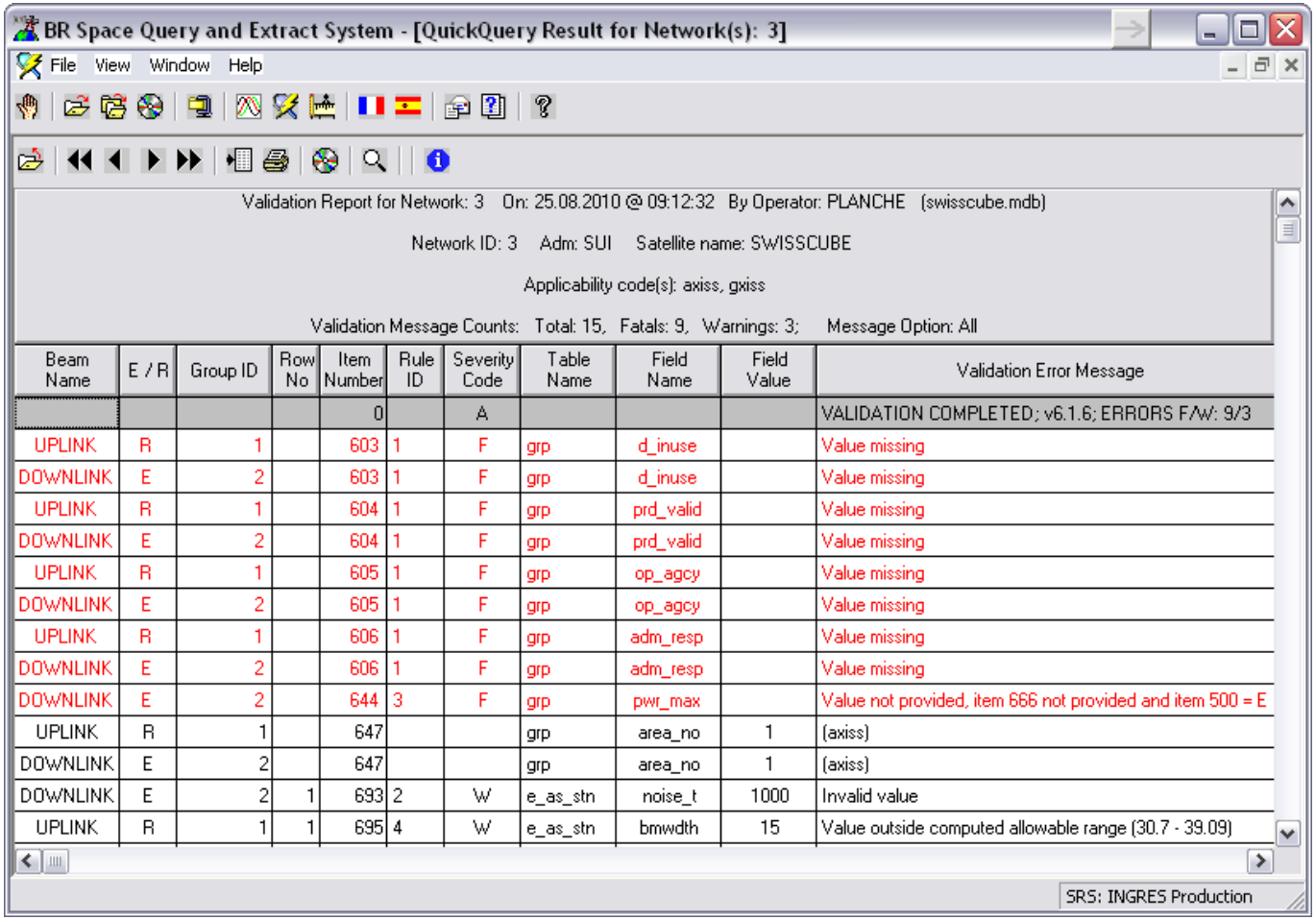


WHEN THE VALIDATION IS COMPLETED DISPLAY THE VALIDATION REPORT

STEP 4



PROCEED WITH ANALYZE AND CORRECTIONS



Beam Name	E / R	Group ID	Row No	Item Number	Rule ID	Severity Code	Table Name	Field Name	Field Value	Validation Error Message
				0		A				VALIDATION COMPLETED; v6.1.6; ERRORS F/W: 9/3
UPLINK	R	1		603	1	F	grp	d_inuse		Value missing
DOWNLINK	E	2		603	1	F	grp	d_inuse		Value missing
UPLINK	R	1		604	1	F	grp	prd_valid		Value missing
DOWNLINK	E	2		604	1	F	grp	prd_valid		Value missing
UPLINK	R	1		605	1	F	grp	op_agcy		Value missing
DOWNLINK	E	2		605	1	F	grp	op_agcy		Value missing
UPLINK	R	1		606	1	F	grp	adm_resp		Value missing
DOWNLINK	E	2		606	1	F	grp	adm_resp		Value missing
DOWNLINK	E	2		644	3	F	grp	pwr_max		Value not provided, item 666 not provided and item 500 = E
UPLINK	R	1		647			grp	area_no	1	(axiss)
DOWNLINK	E	2		647			grp	area_no	1	(axiss)
DOWNLINK	E	2	1	693	2	W	e_as_stn	noise_t	1000	Invalid value
UPLINK	R	1	1	695	4	W	e_as_stn	bmwdth	15	Value outside computed allowable range (30.7 - 39.09)

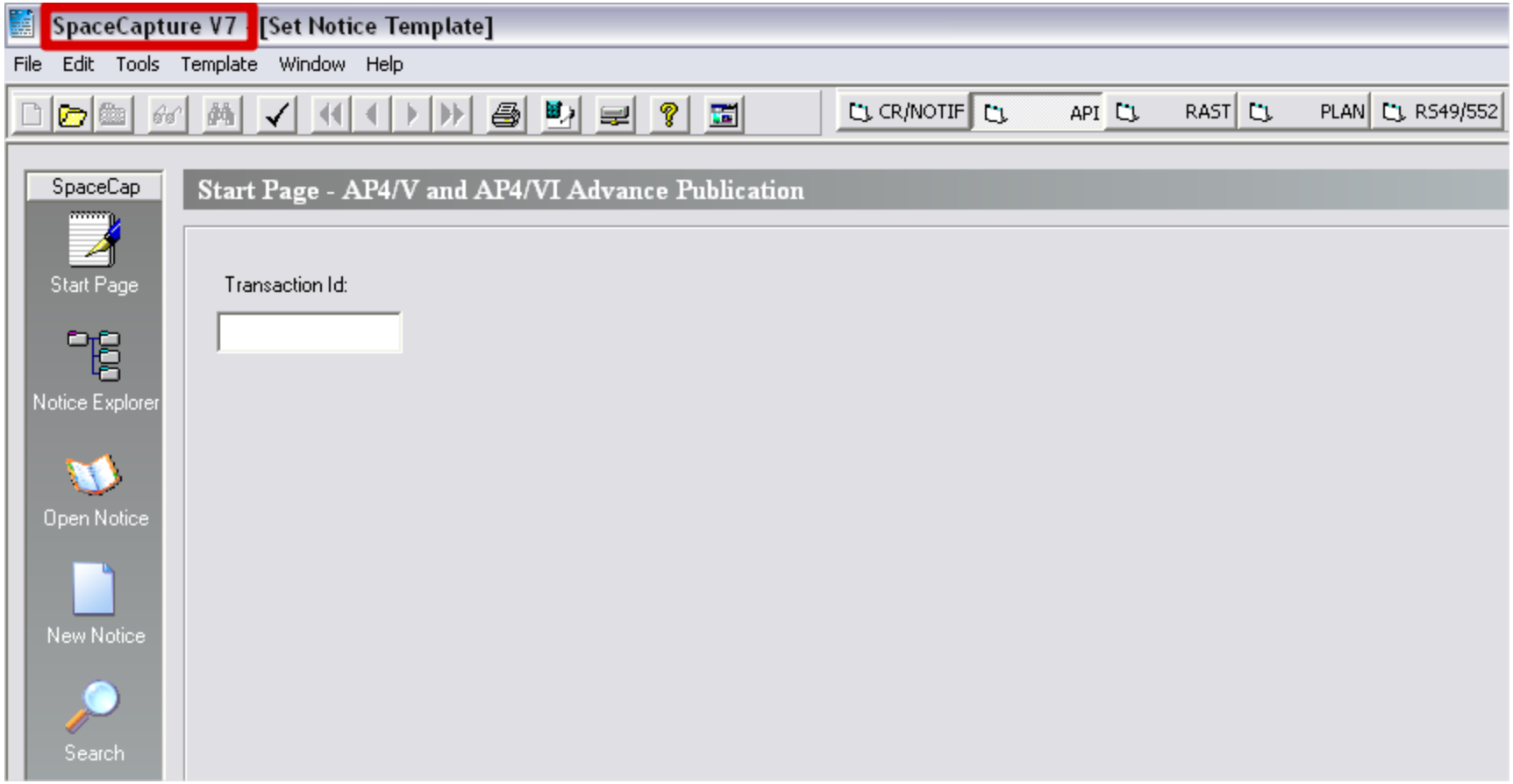
CUBESAT

NOTIFICATION CAPTURE

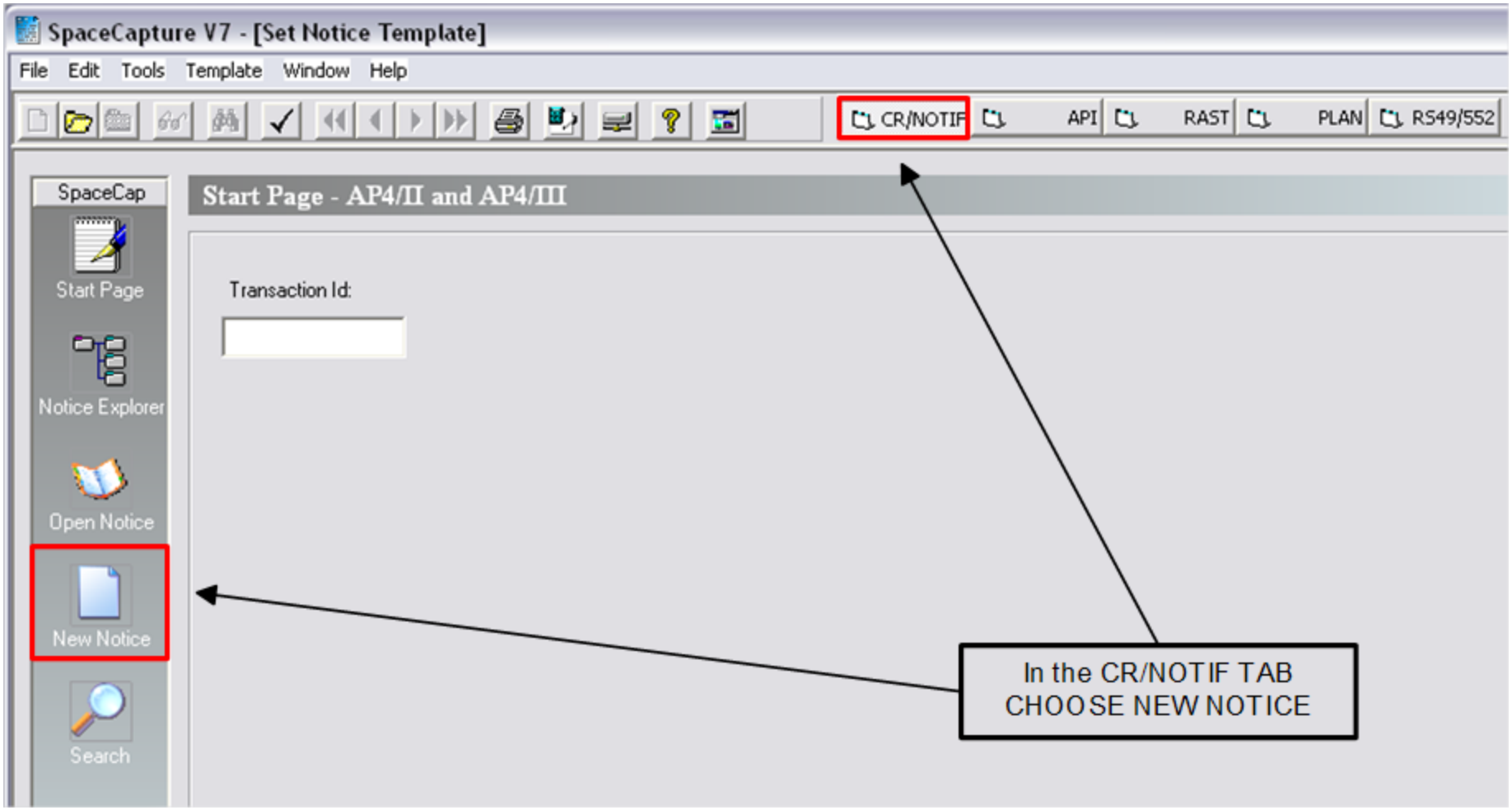
SPACECAP VERSION 7

Verify that you have the latest version of SpaceCap

http://www.itu.int/ITU-R/go/space-software/

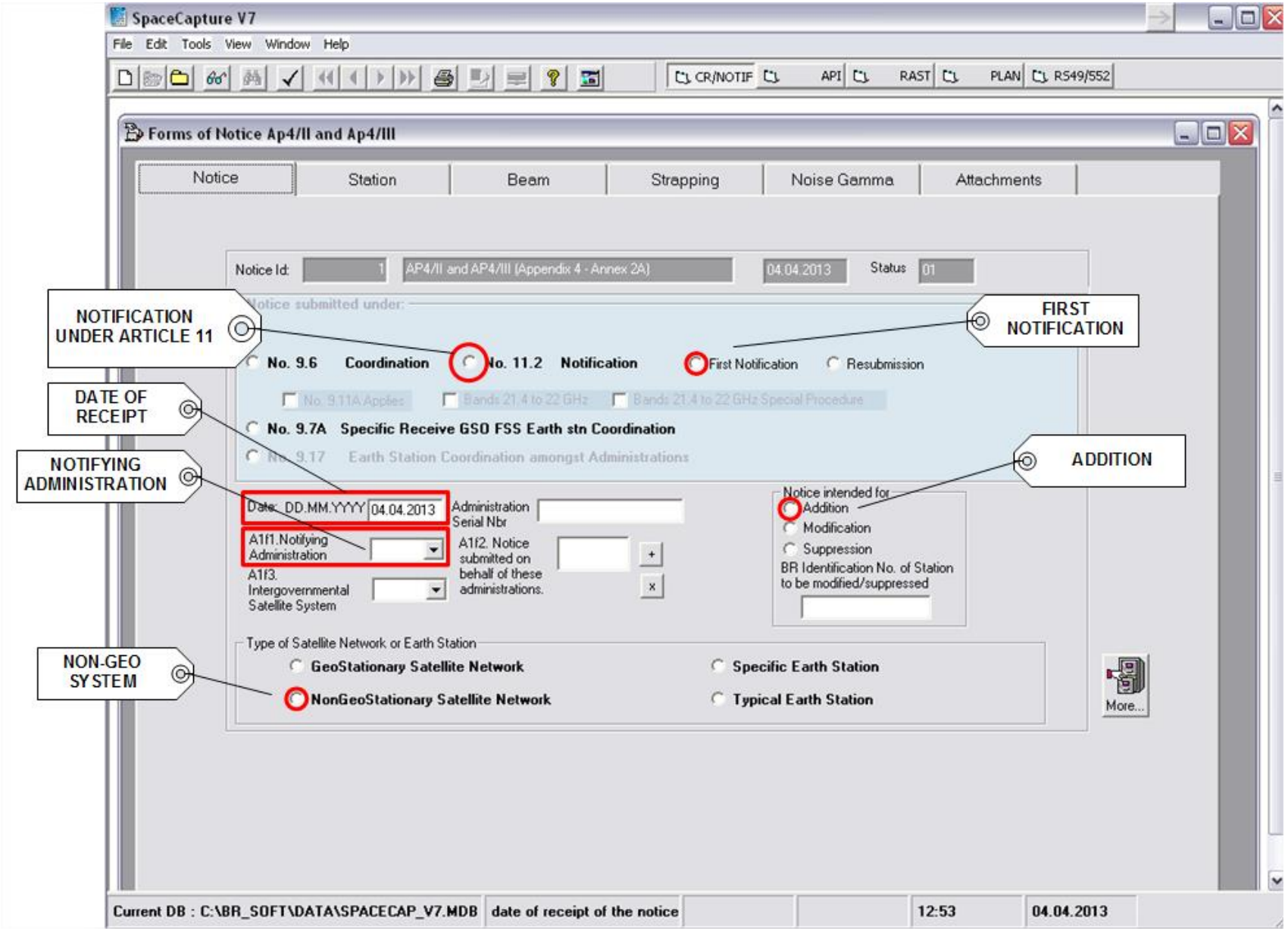


NOTIFICATION



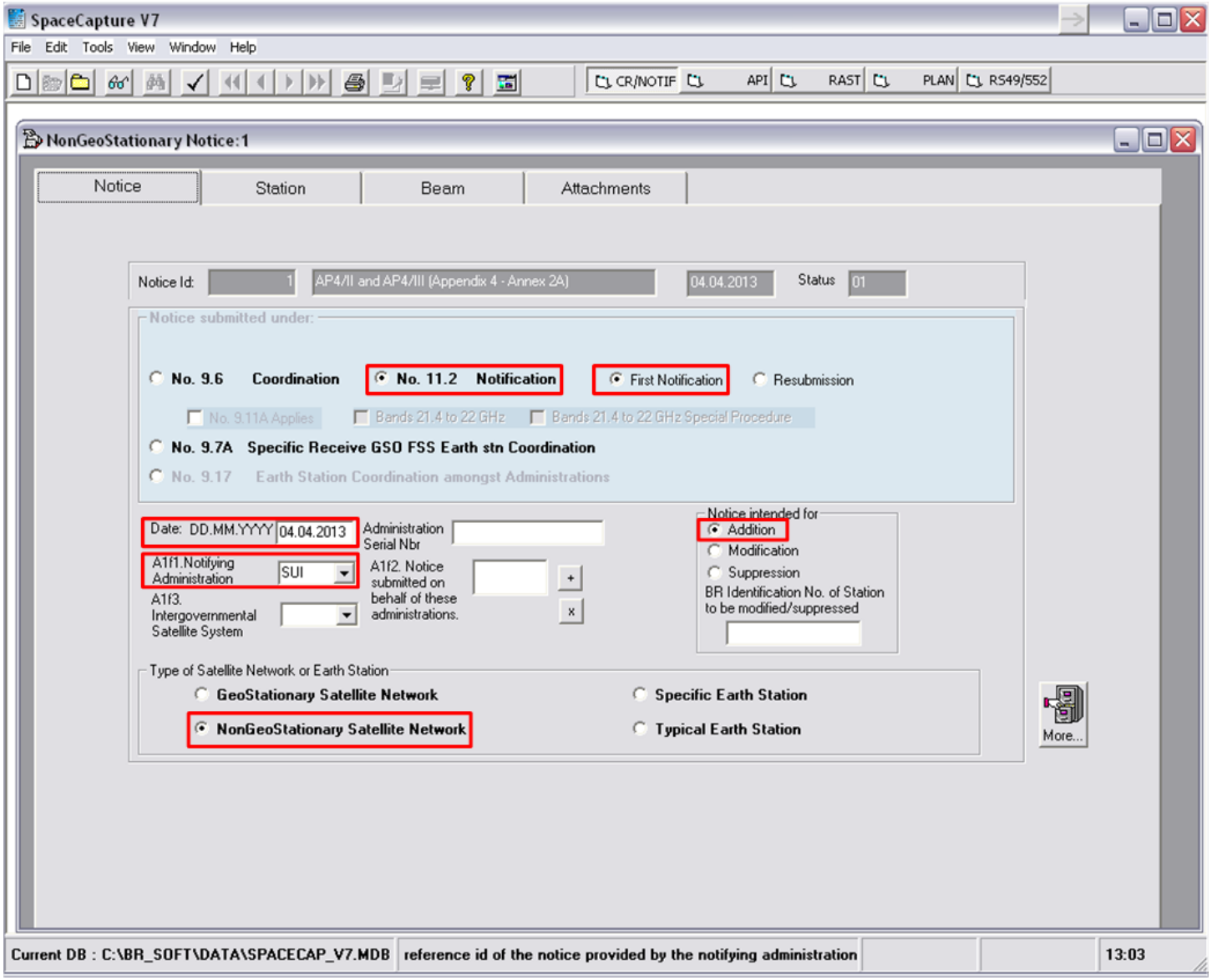
NOTIFICATION

CAPTURE THE MAIN CHARACTERISTICS OF THE NETWORK

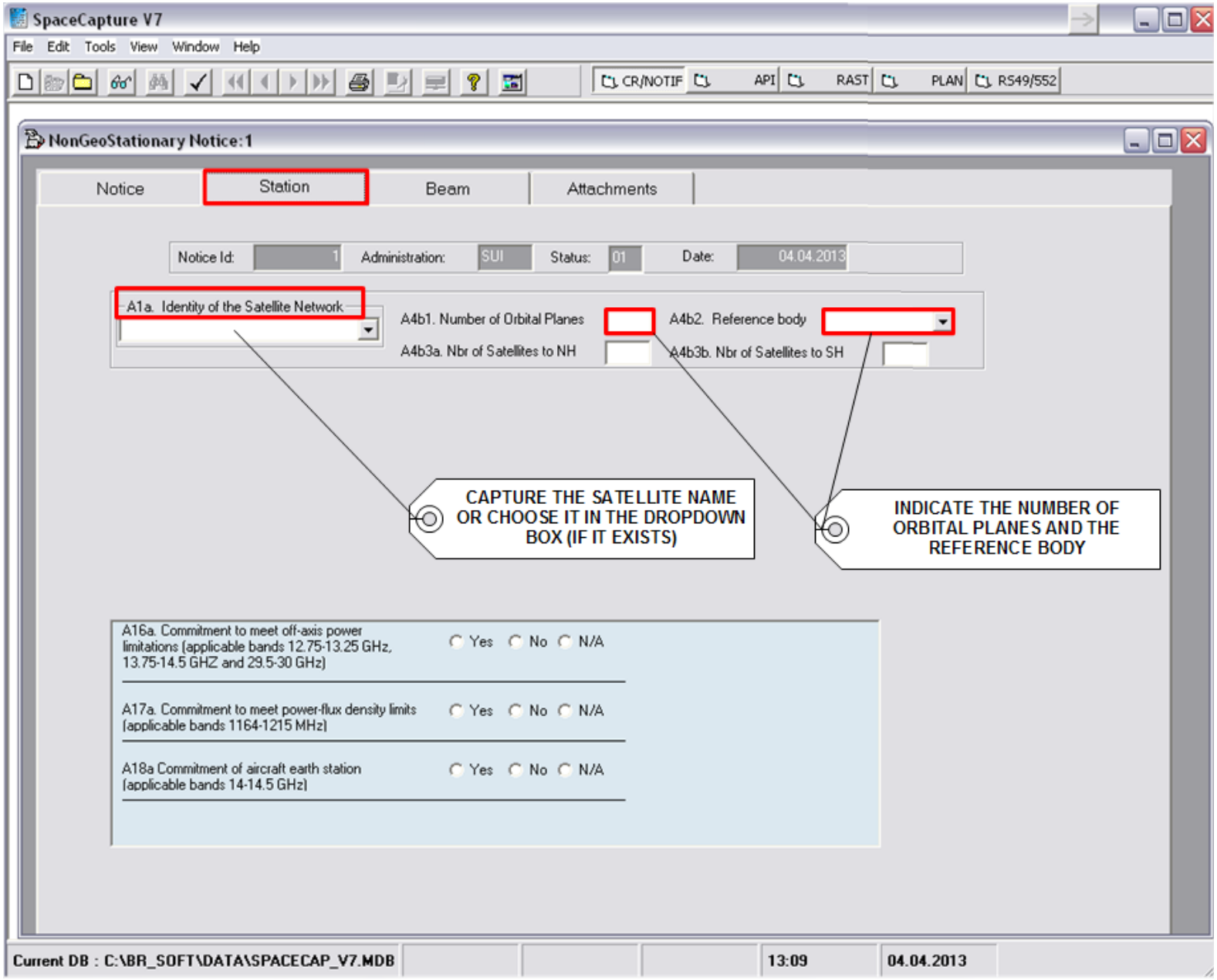


NOTIFICATION

BY DEFAULT THE SUBMISSION WILL BE FILLED AS AN ADDITION, FIRST SUBMISSION, WITH THE DATE OF THE CAPTURE AS THE DATE OF RECEIPT

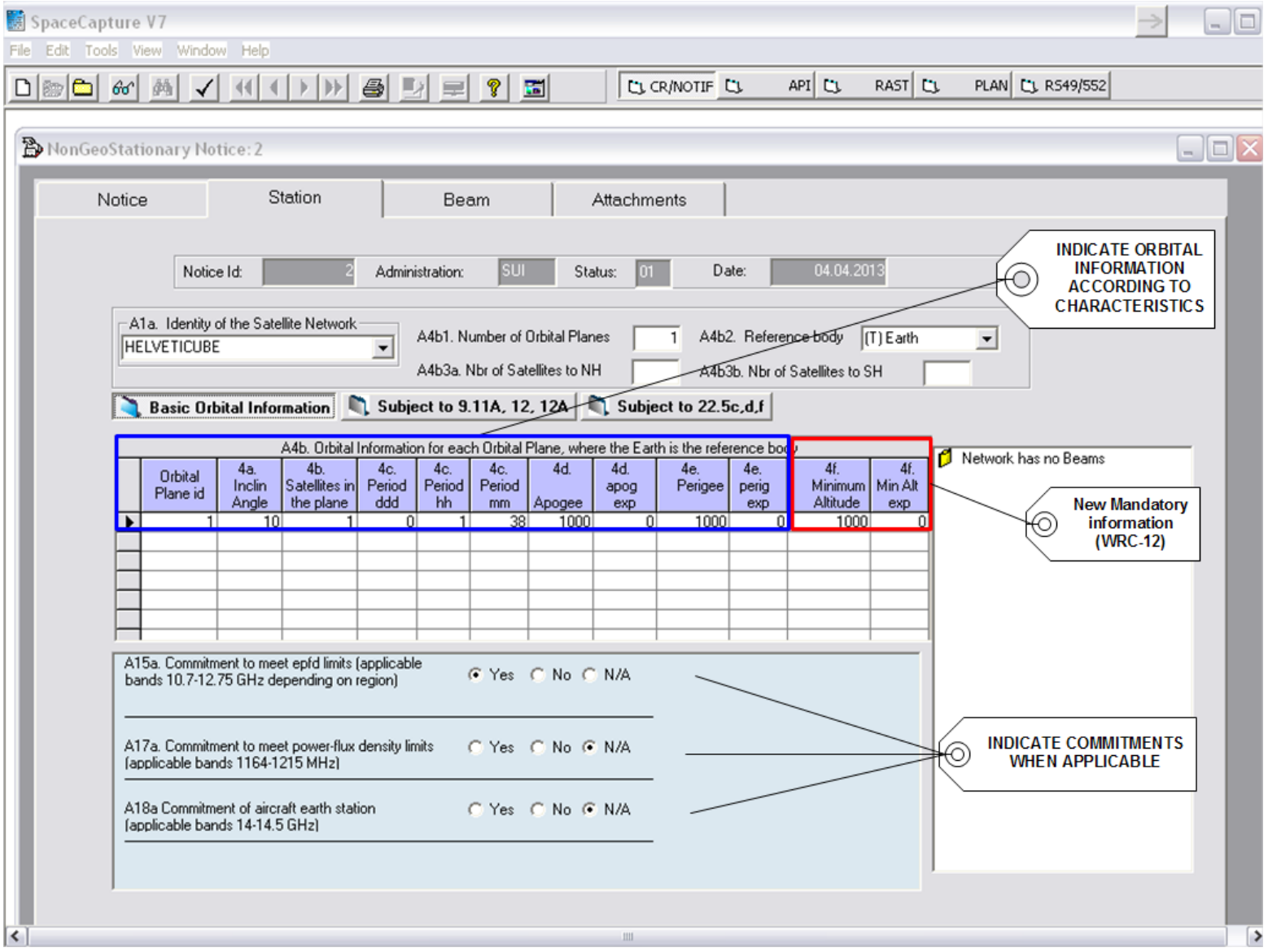


NOTIFICATION



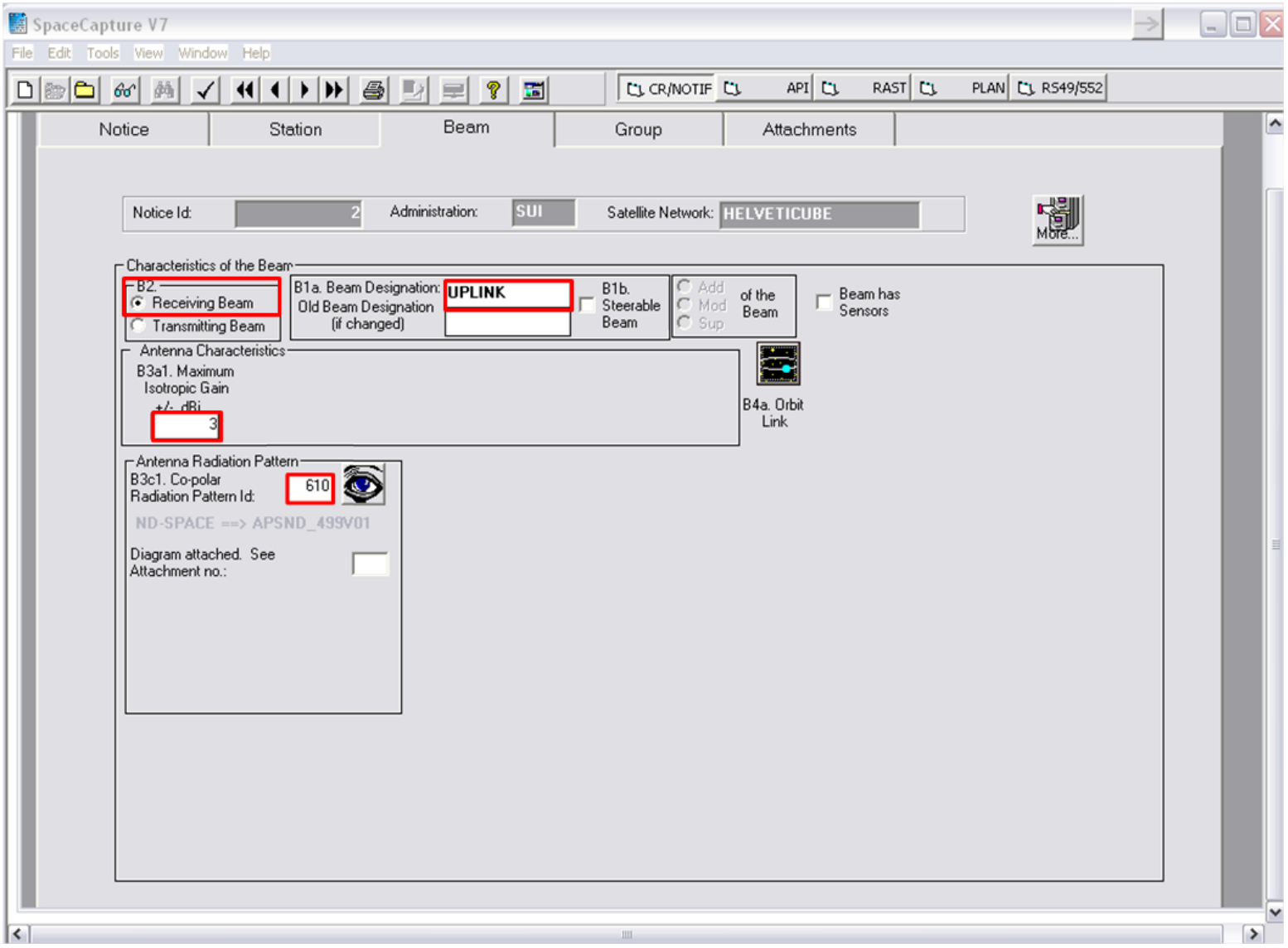
NOTIFICATION

AFTER THE CAPTURE OF THE REFERENCE BODY, NEW FIELDS CONCERNING ORBITAL CHARACTERISTICS WILL APPEAR



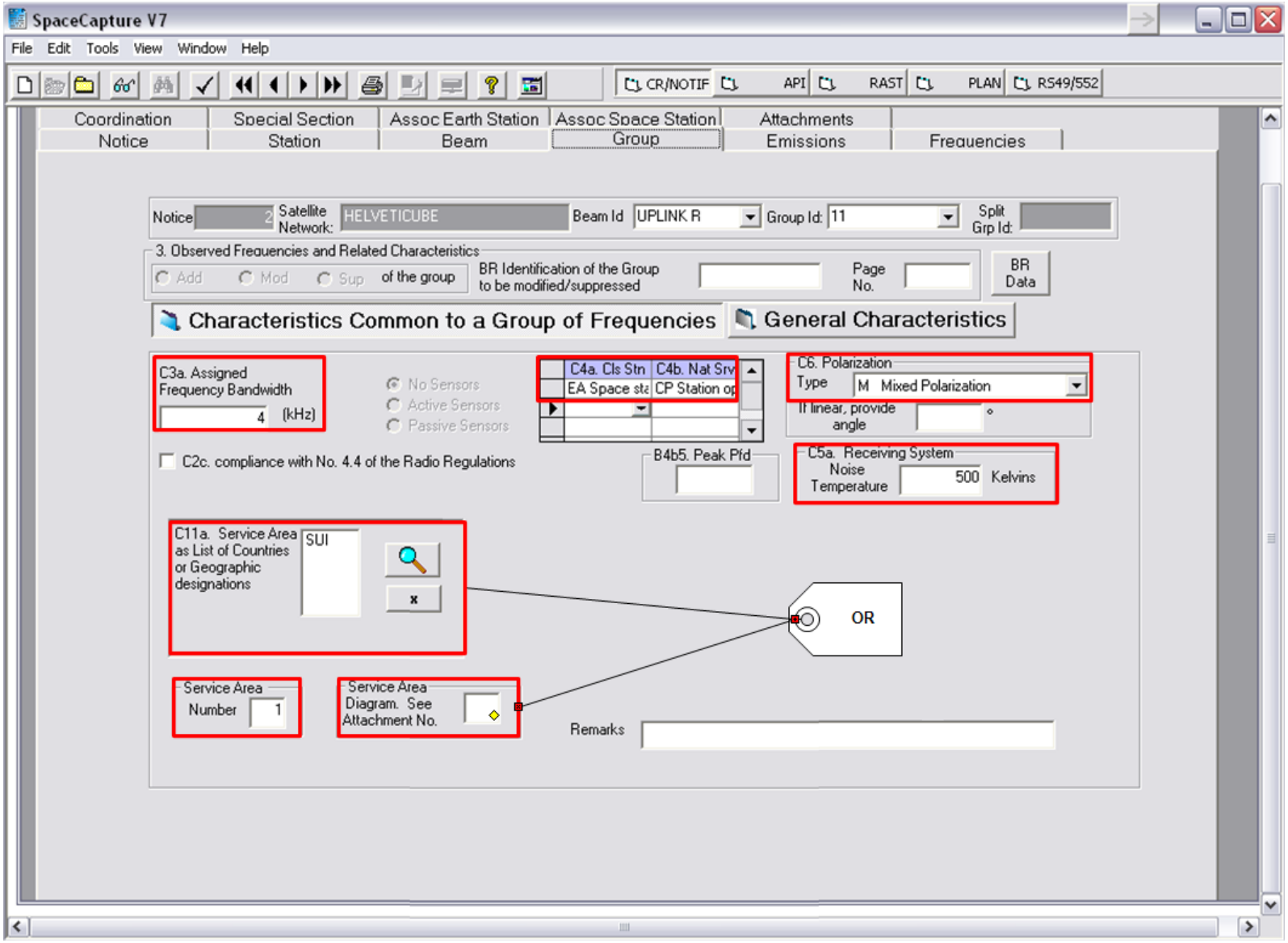
NOTIFICATION

CAPTURE CHARACTERISTICS OF THE RECEIVING BEAM



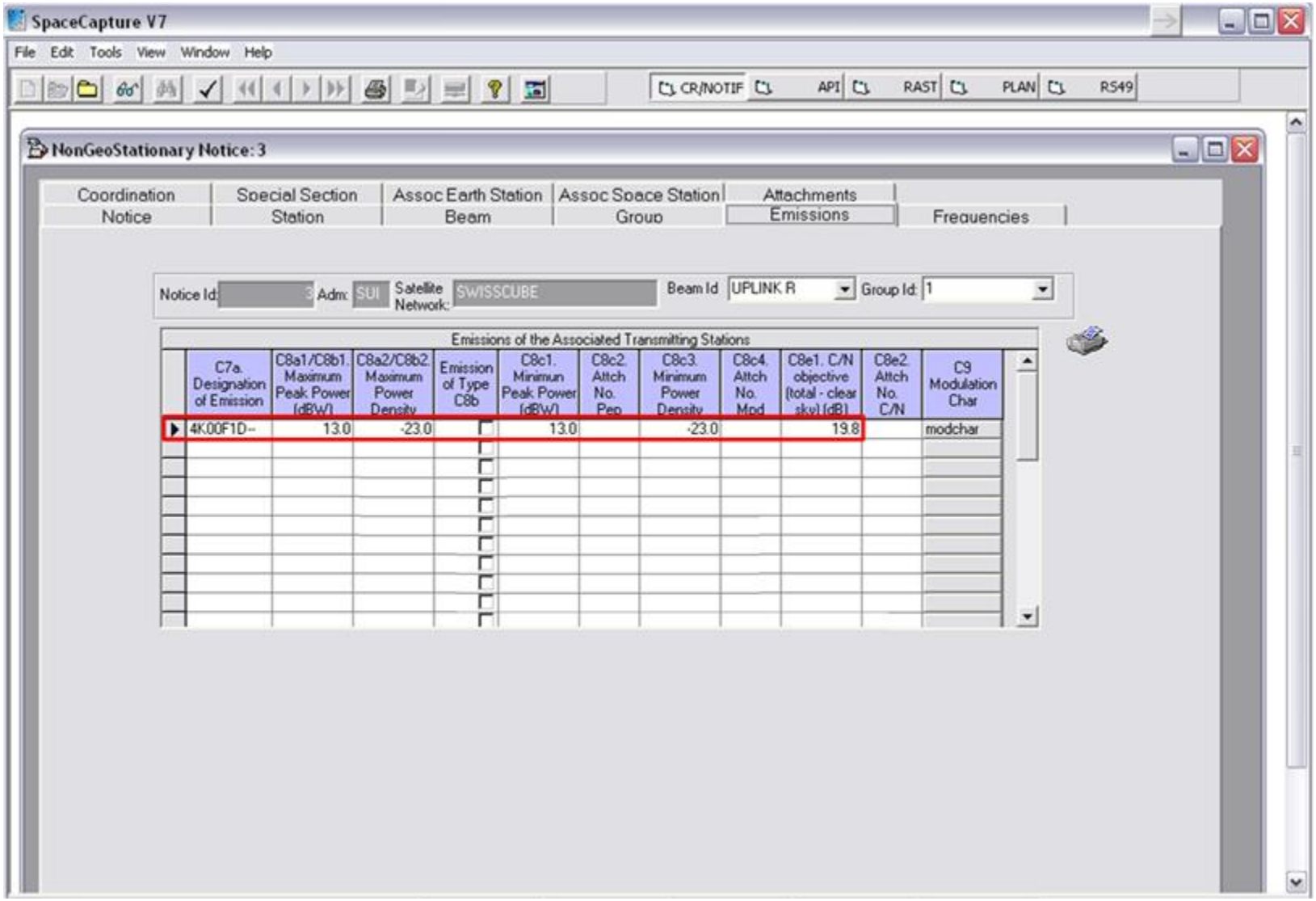
NOTIFICATION

CAPTURE CHARACTERISTICS OF THE GROUP(S)



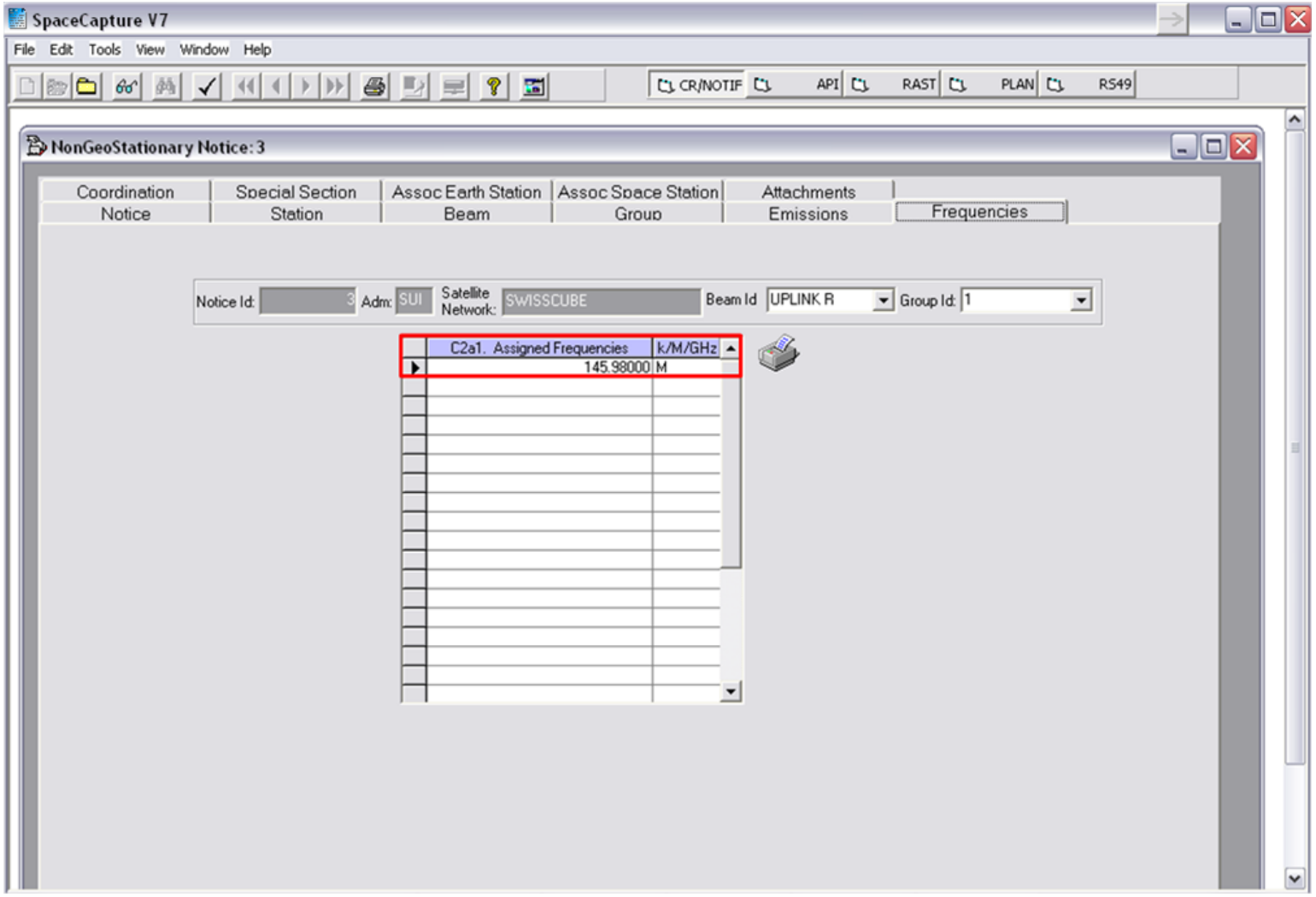
NOTIFICATION

CAPTURE CHARACTERISTICS OF THE EMISSIONS



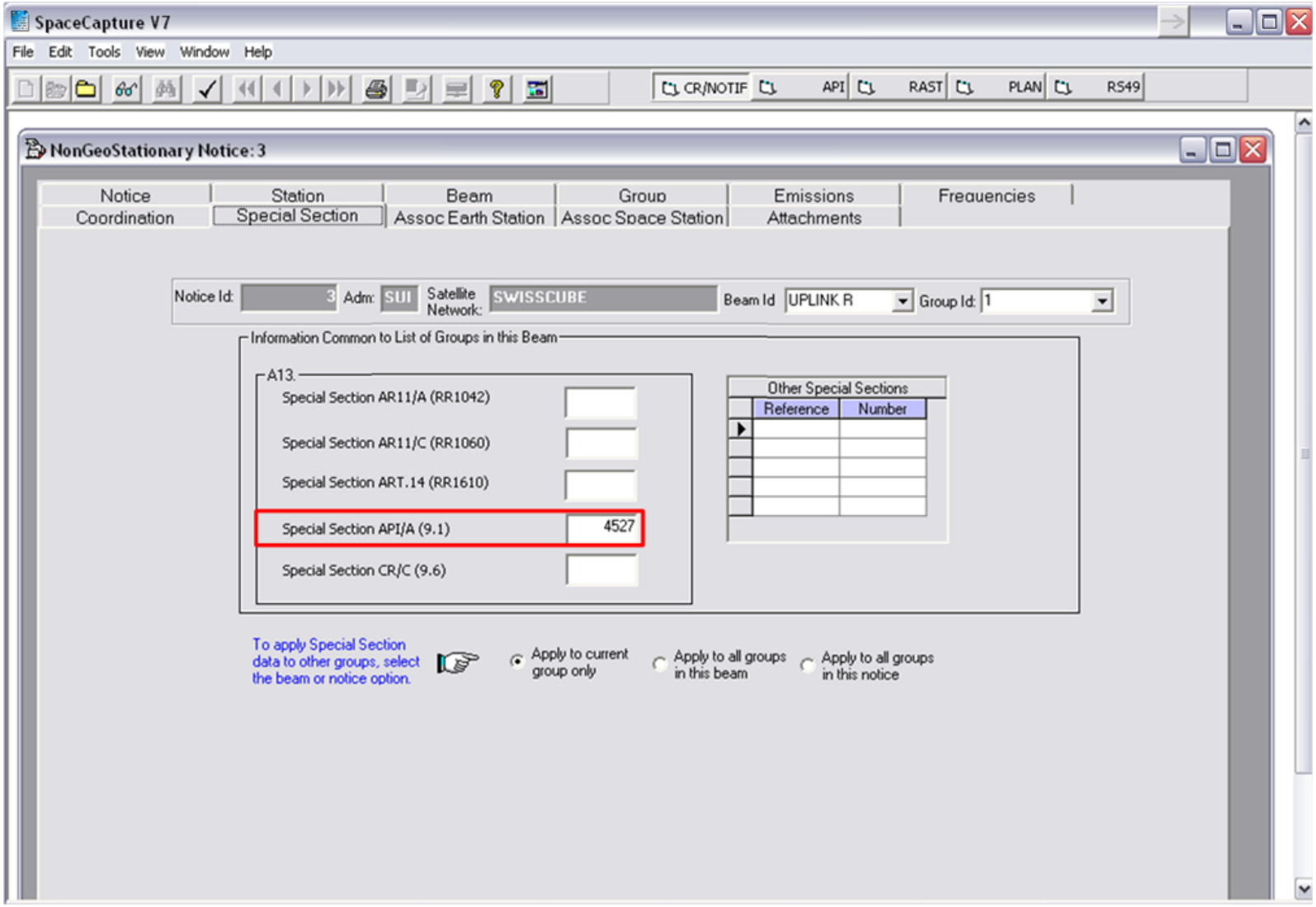
NOTIFICATION

CAPTURE FREQUENCY ASSIGNMENTS



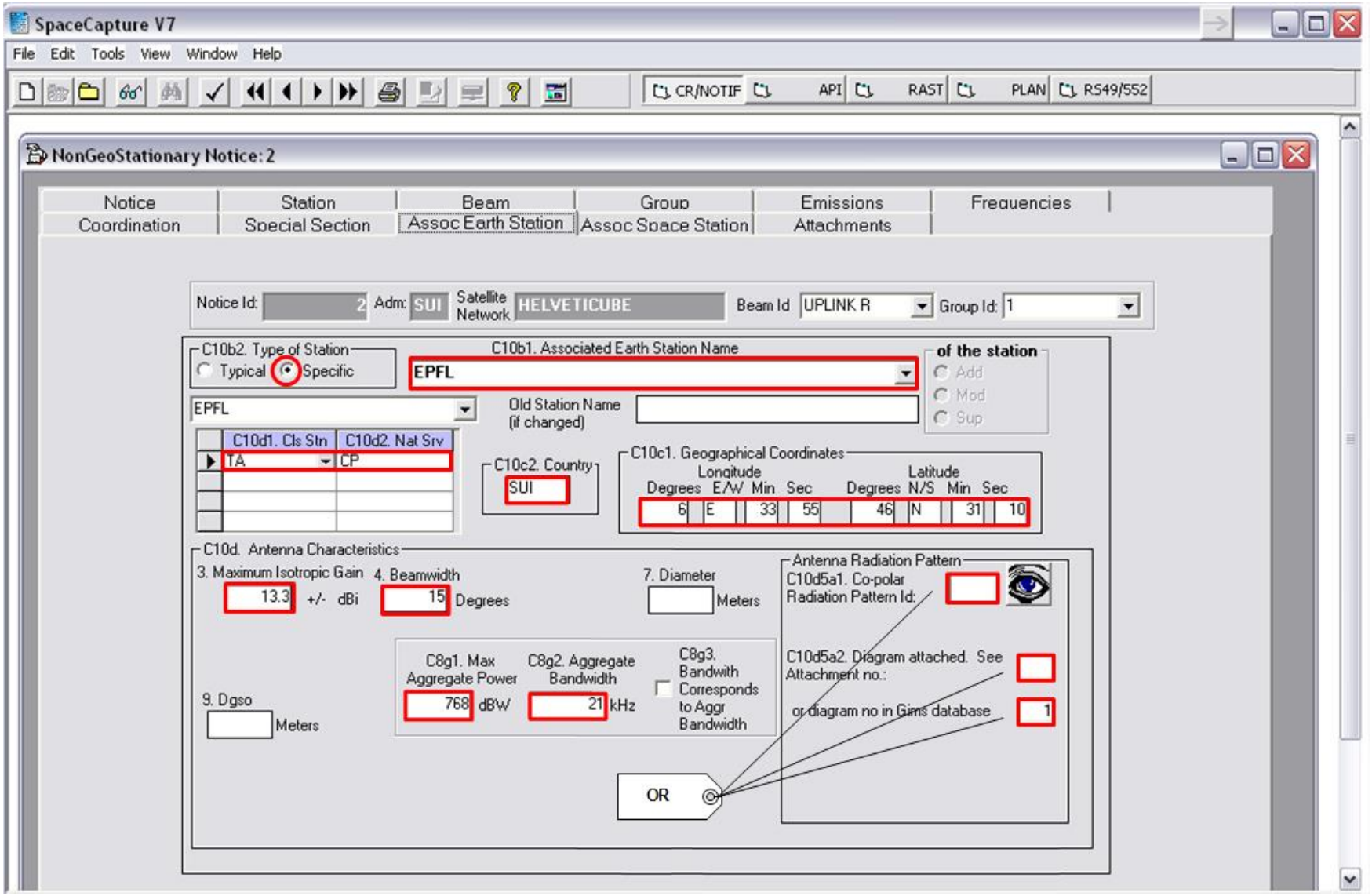
NOTIFICATION

CAPTURE CORRESPONDING SPECIAL SECTION REFERENCE



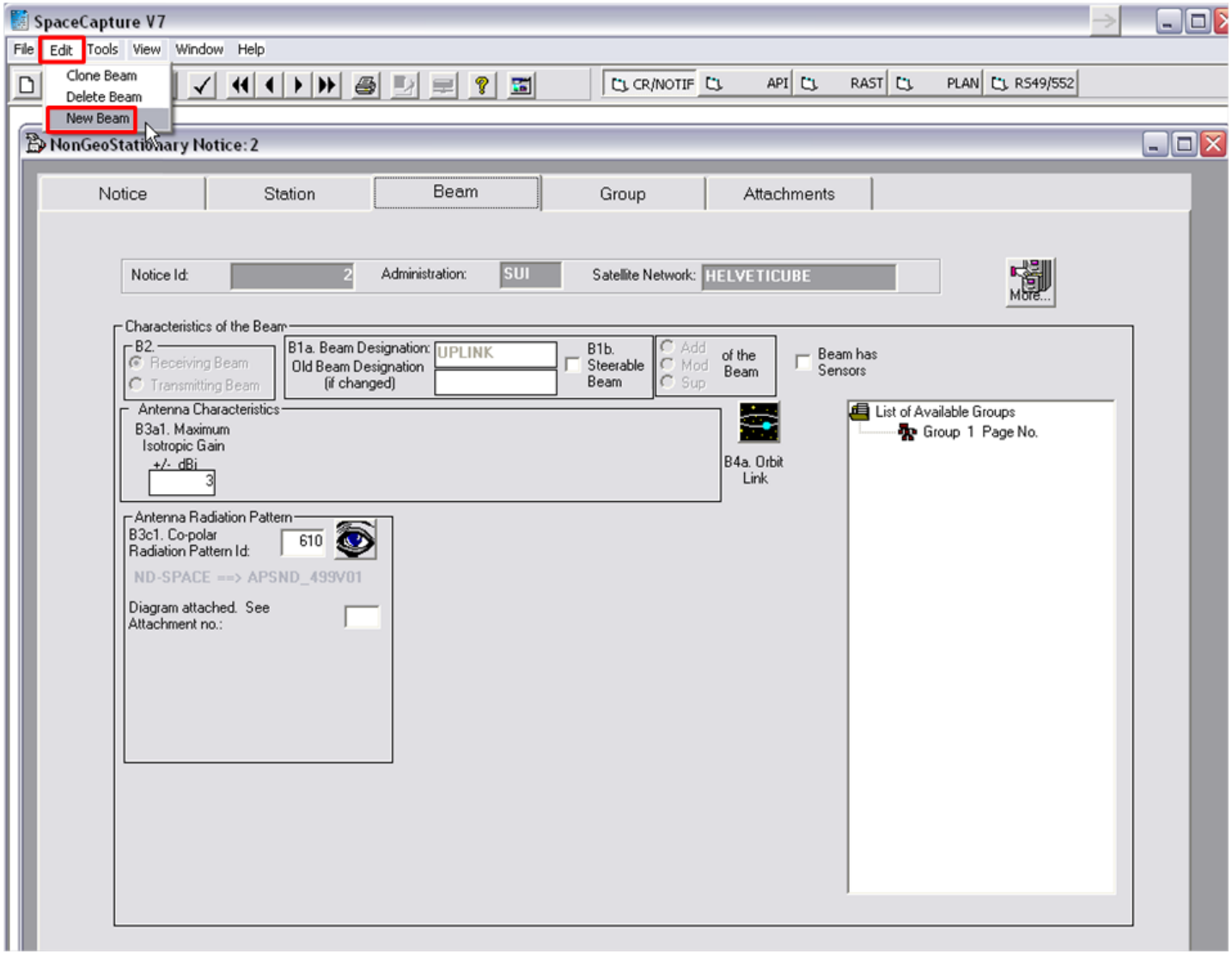
NOTIFICATION

CAPTURE THE ASSOCIATED EARTH OR SPACE STATION

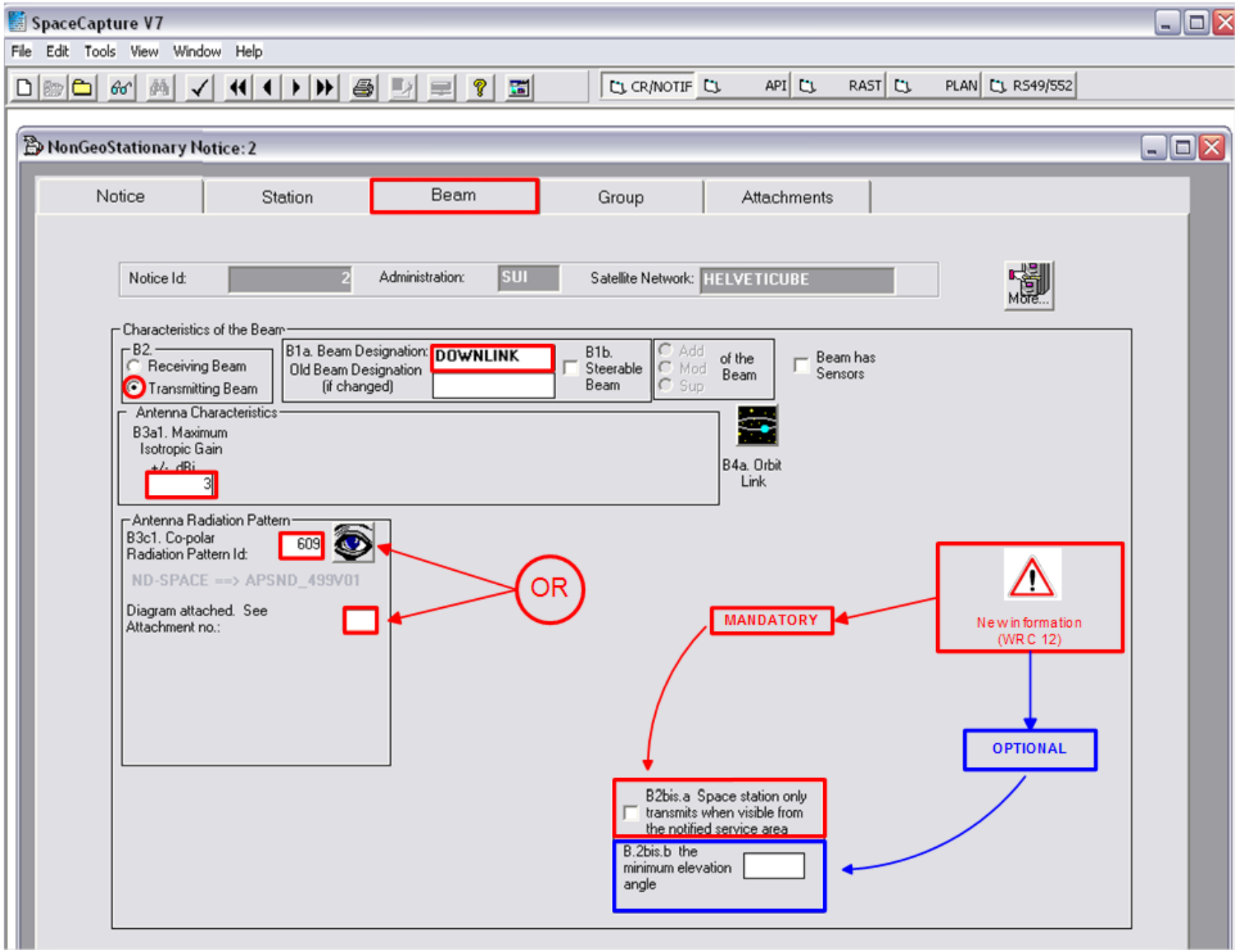


NOTIFICATION

PROCEED WITH THE NEXT BEAM

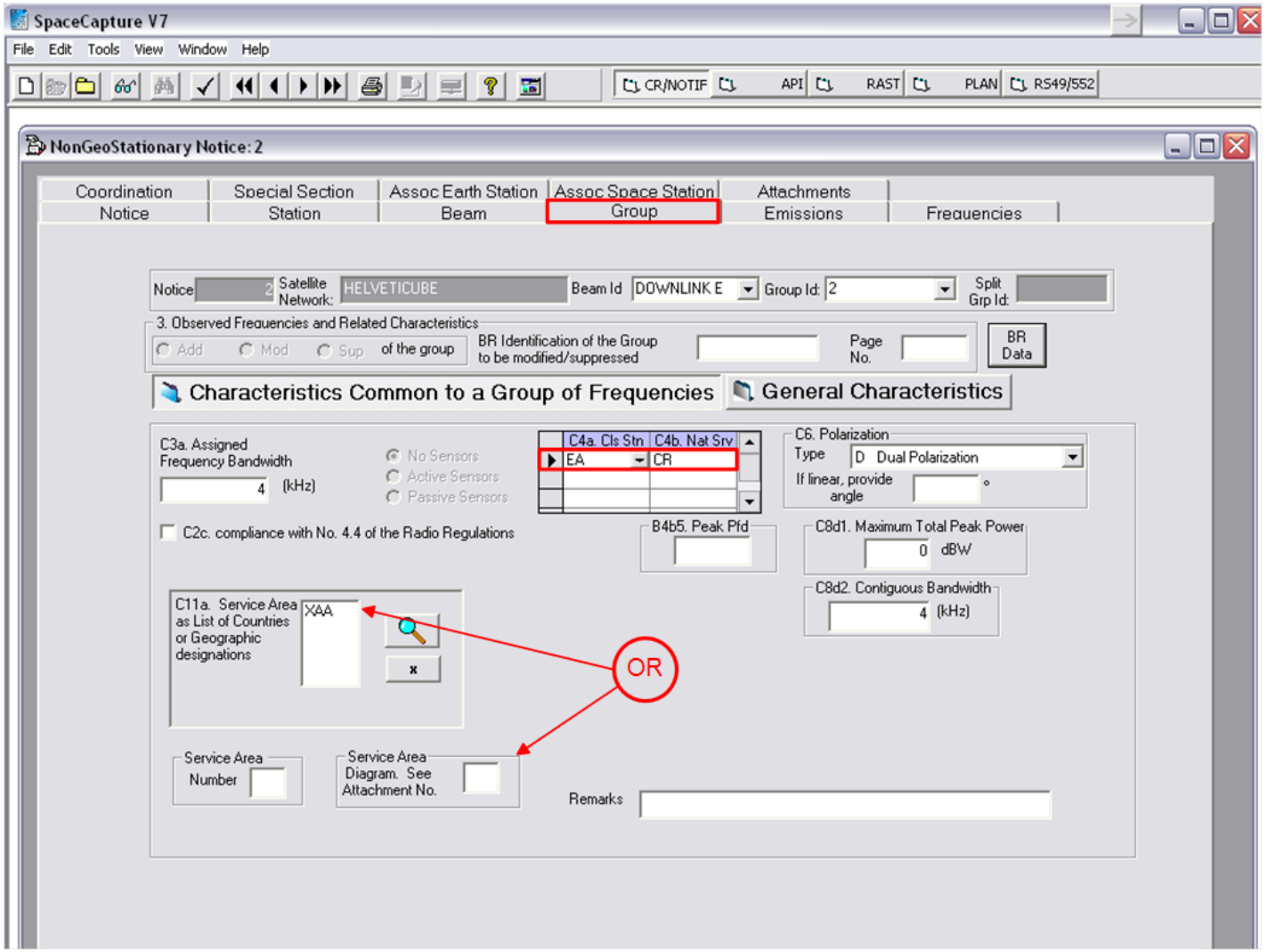


NOTIFICATION



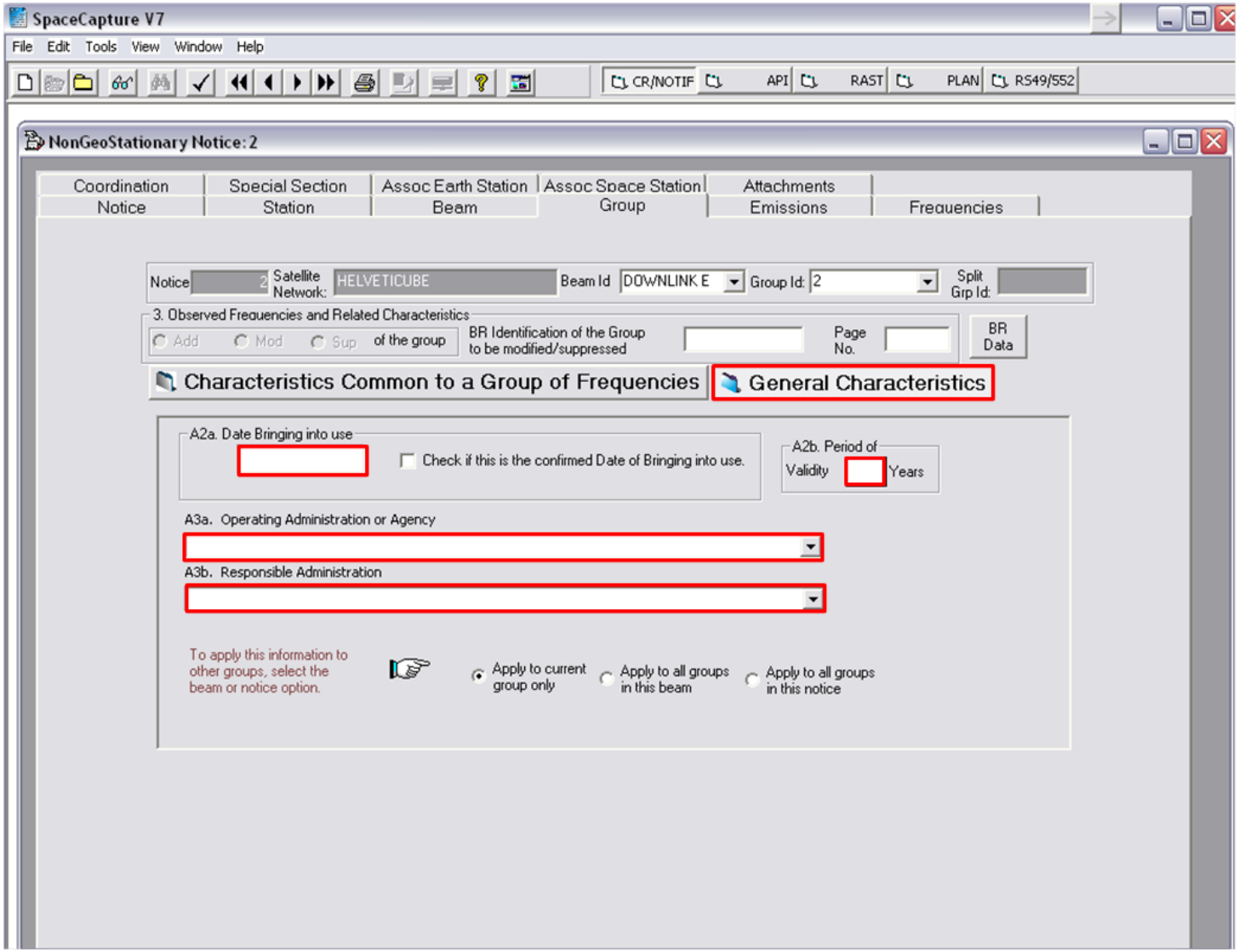
NOTIFICATION

CAPTURE CHARACTERISTICS OF THE GROUP(S)



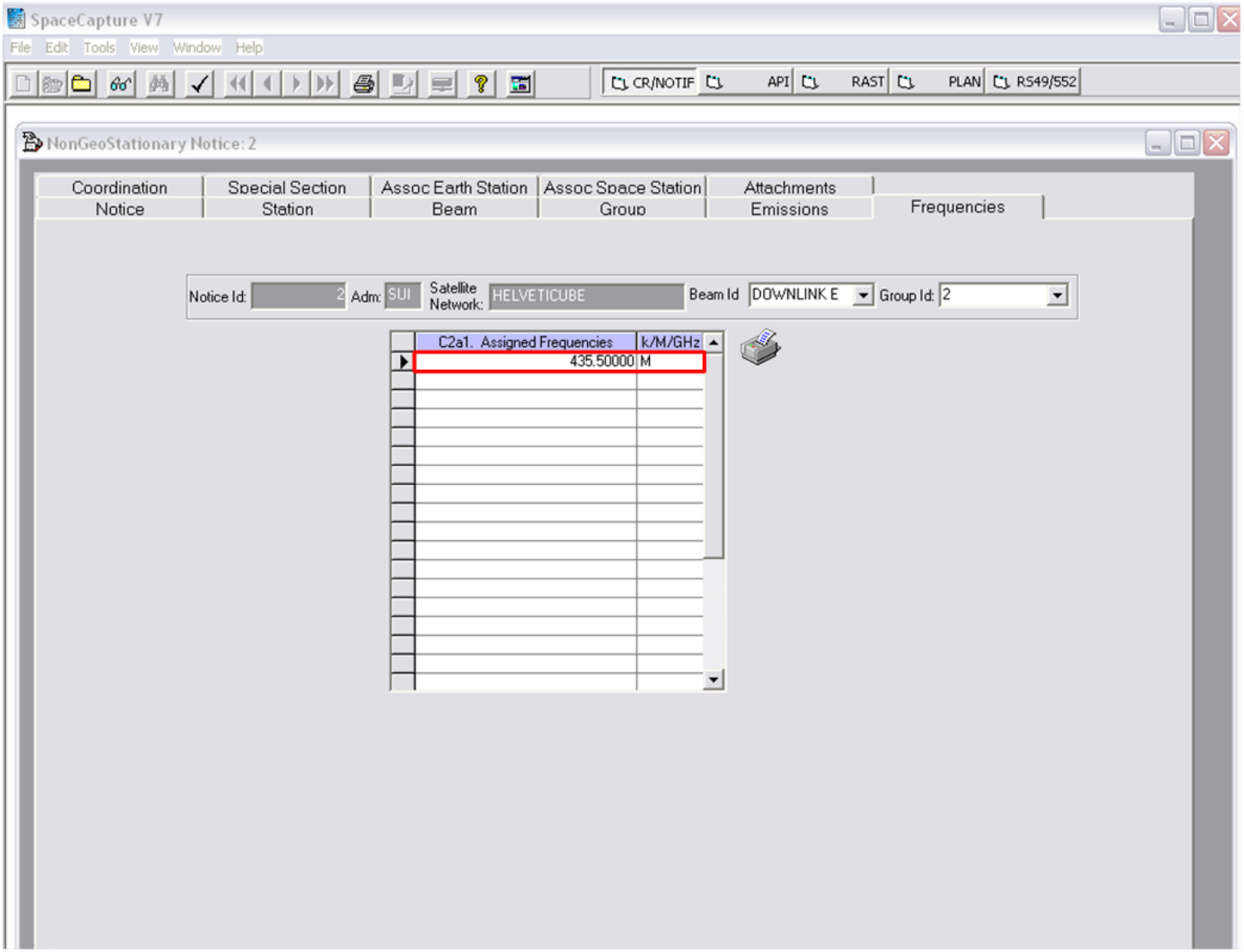
NOTIFICATION

GENERAL CHARACTERISTICS

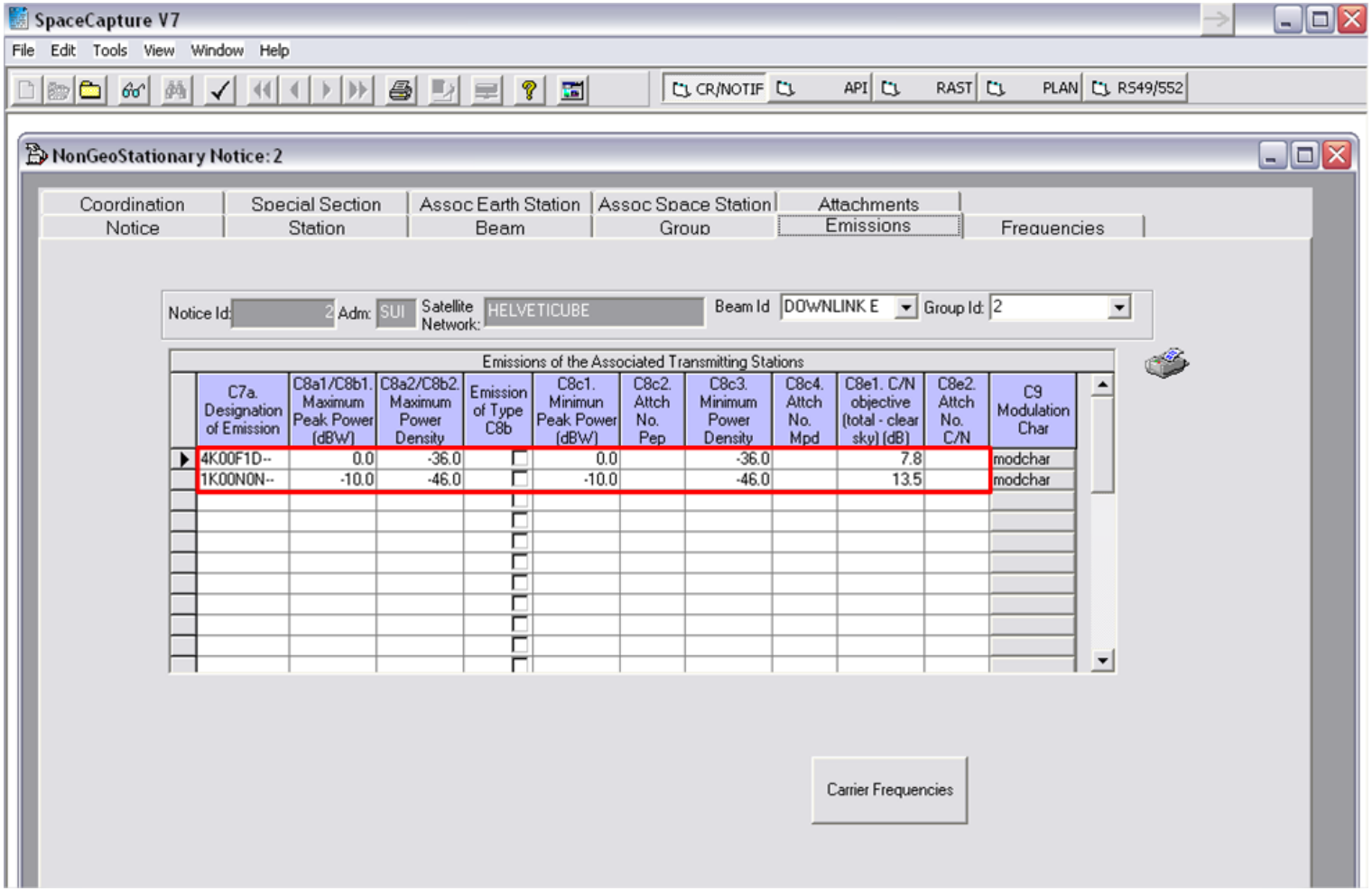


NOTIFICATION

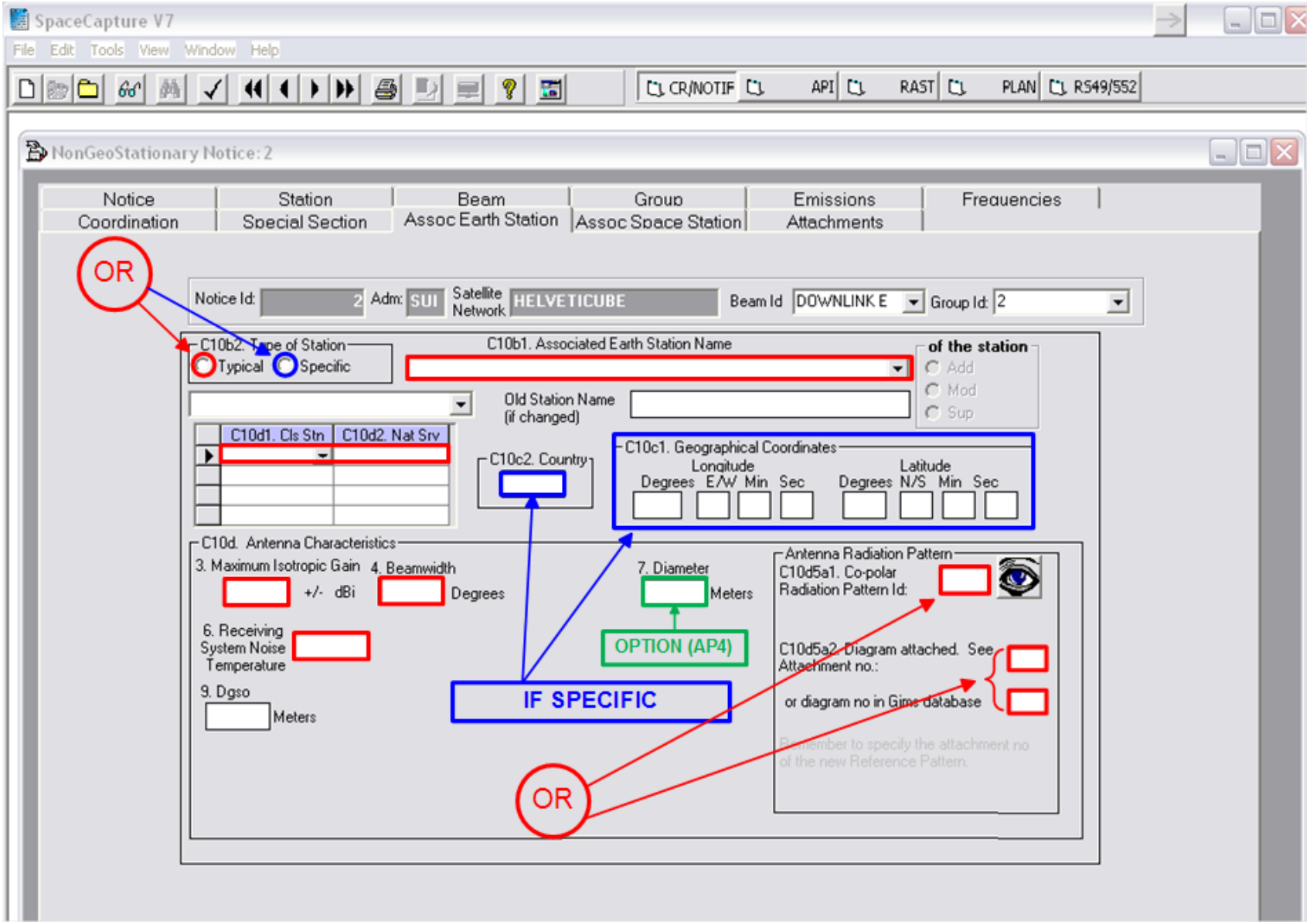
ASSIGNED FREQUENCY



NOTIFICATION
EMISSIONS

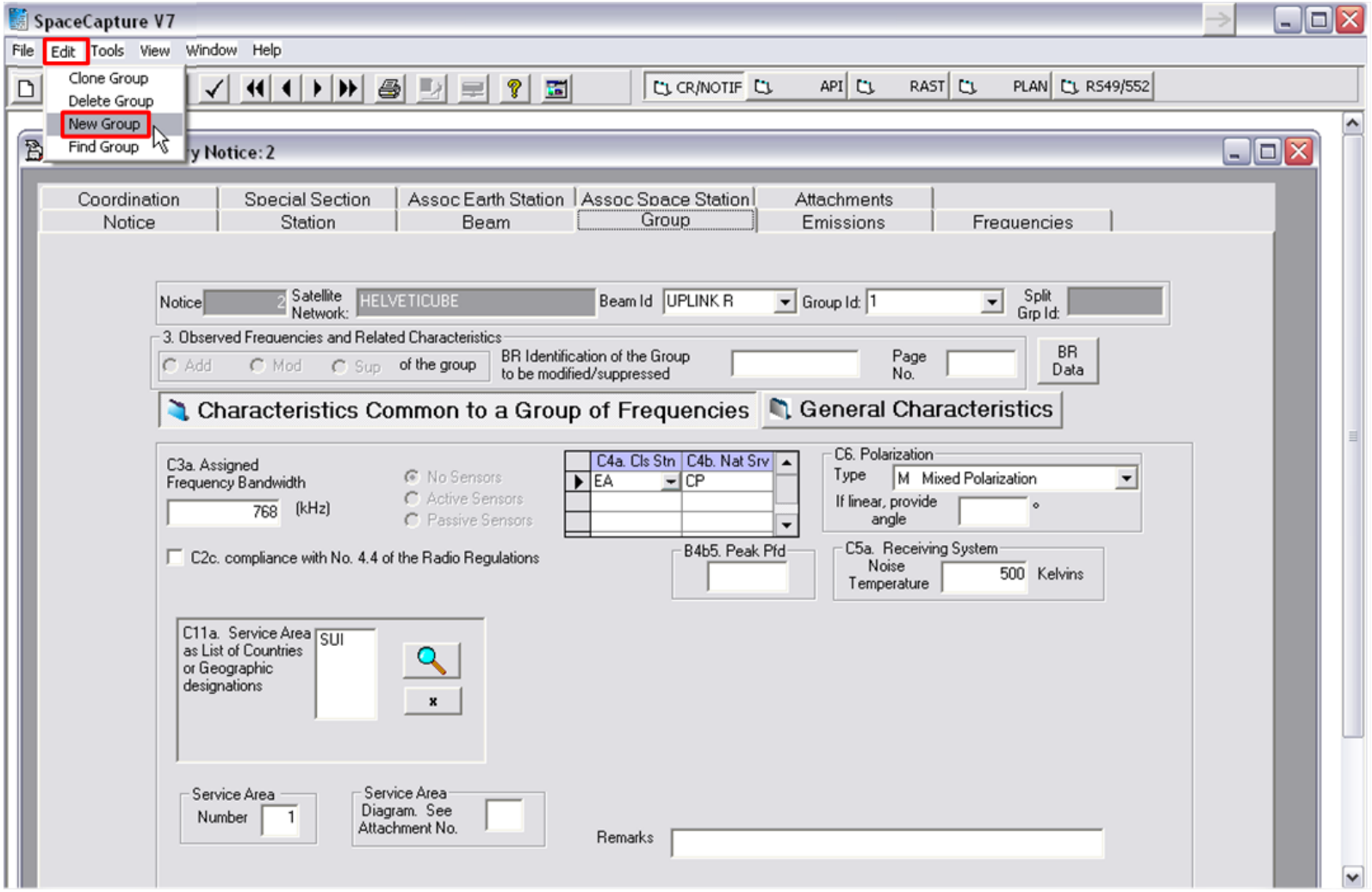


NOTIFICATION
ASSOCIATED EARTH STATION

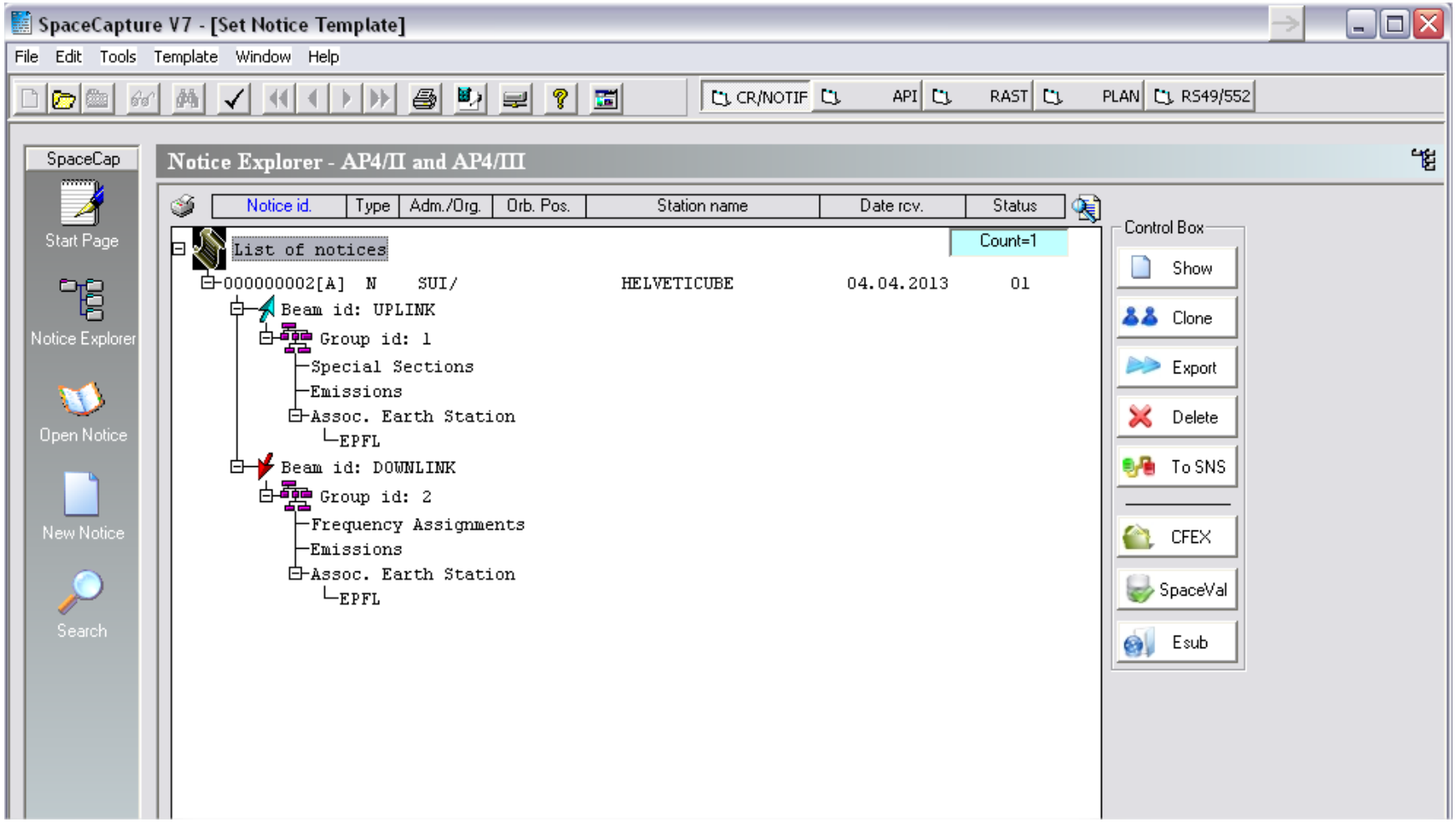


NOTIFICATION

PROCEED WITH THE NEXT GROUP



NOTIFICATION - CAPTURE IS DONE !

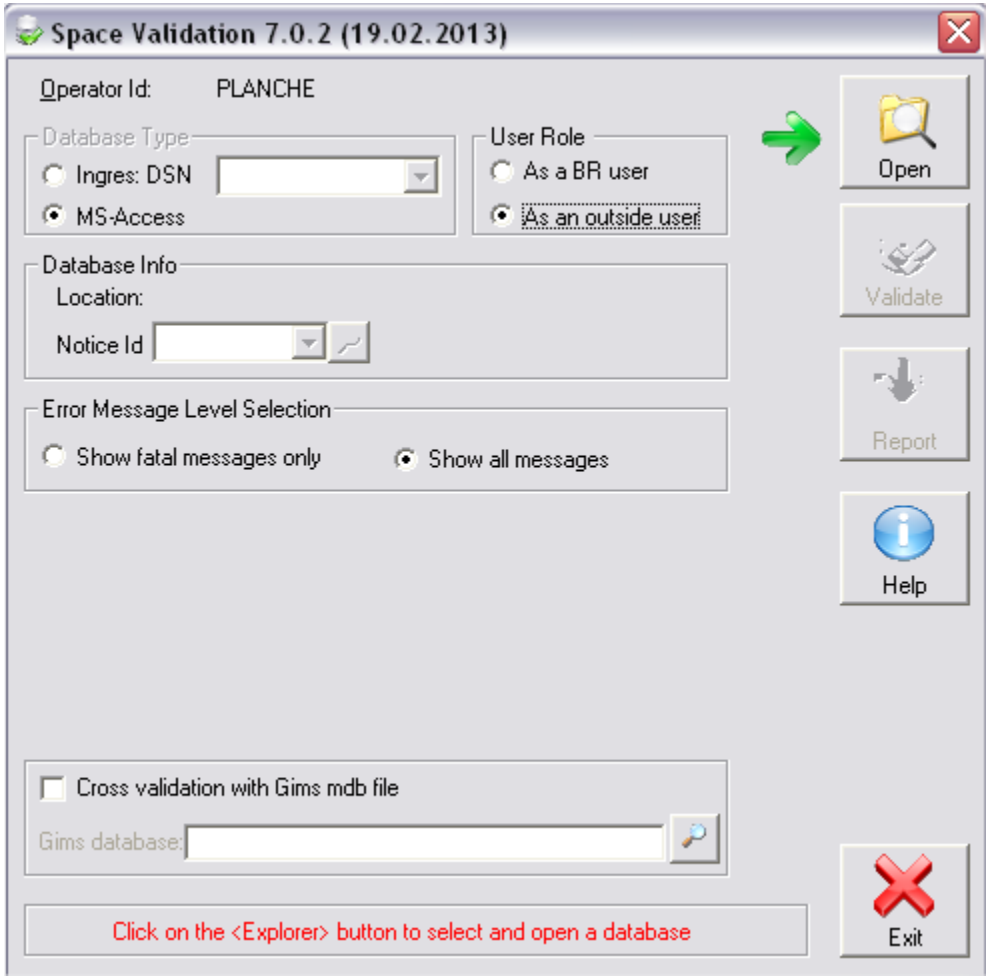


Use the Bureau **SpaceValidation** programme for a

MANDATORY CHECK OF THE DATA CAPTURE RESULT

Verify if you have the latest version of SpaceVal

http://www.itu.int/ITU-R/go/space-software/en



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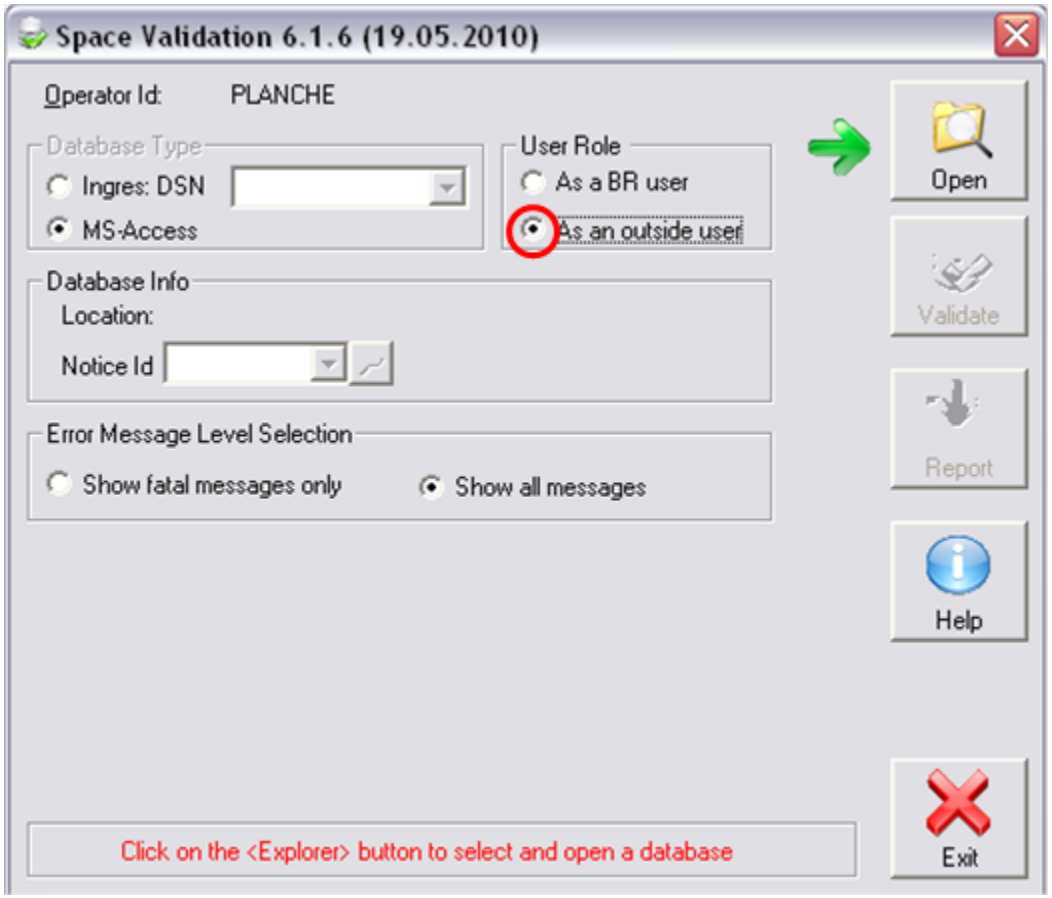
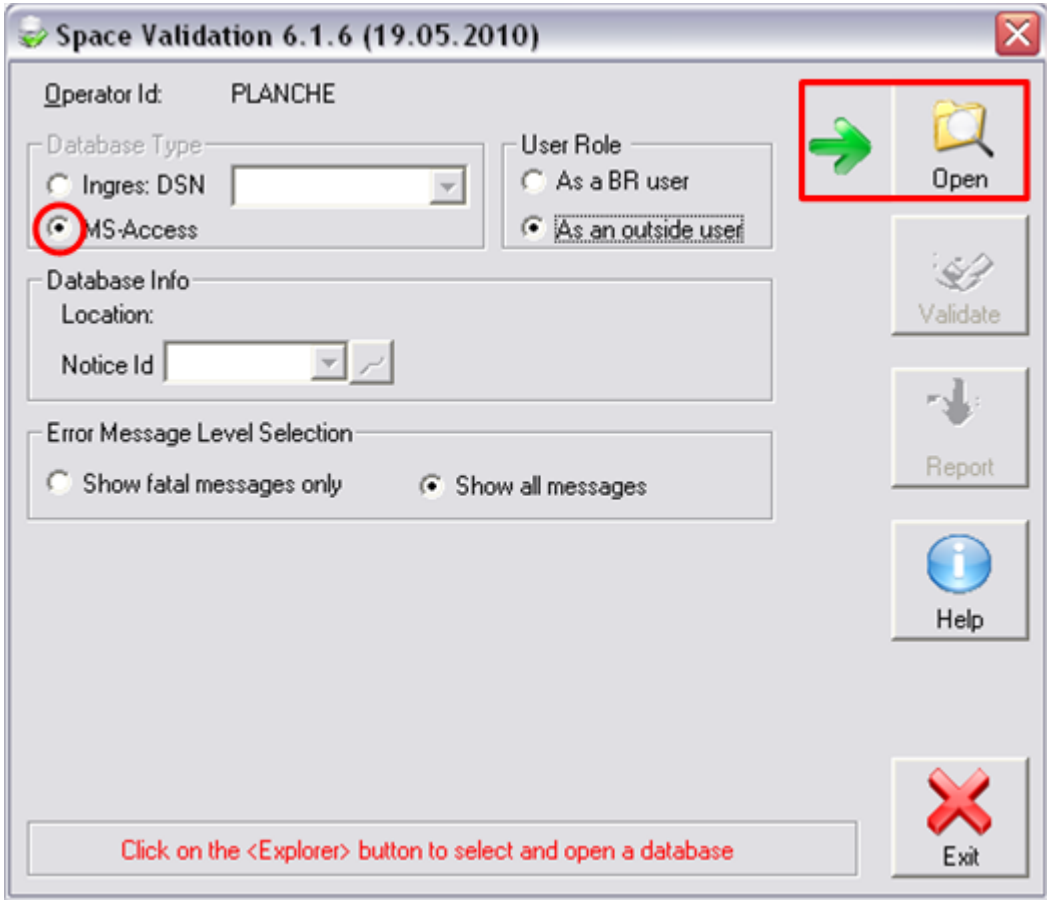
STEP 1

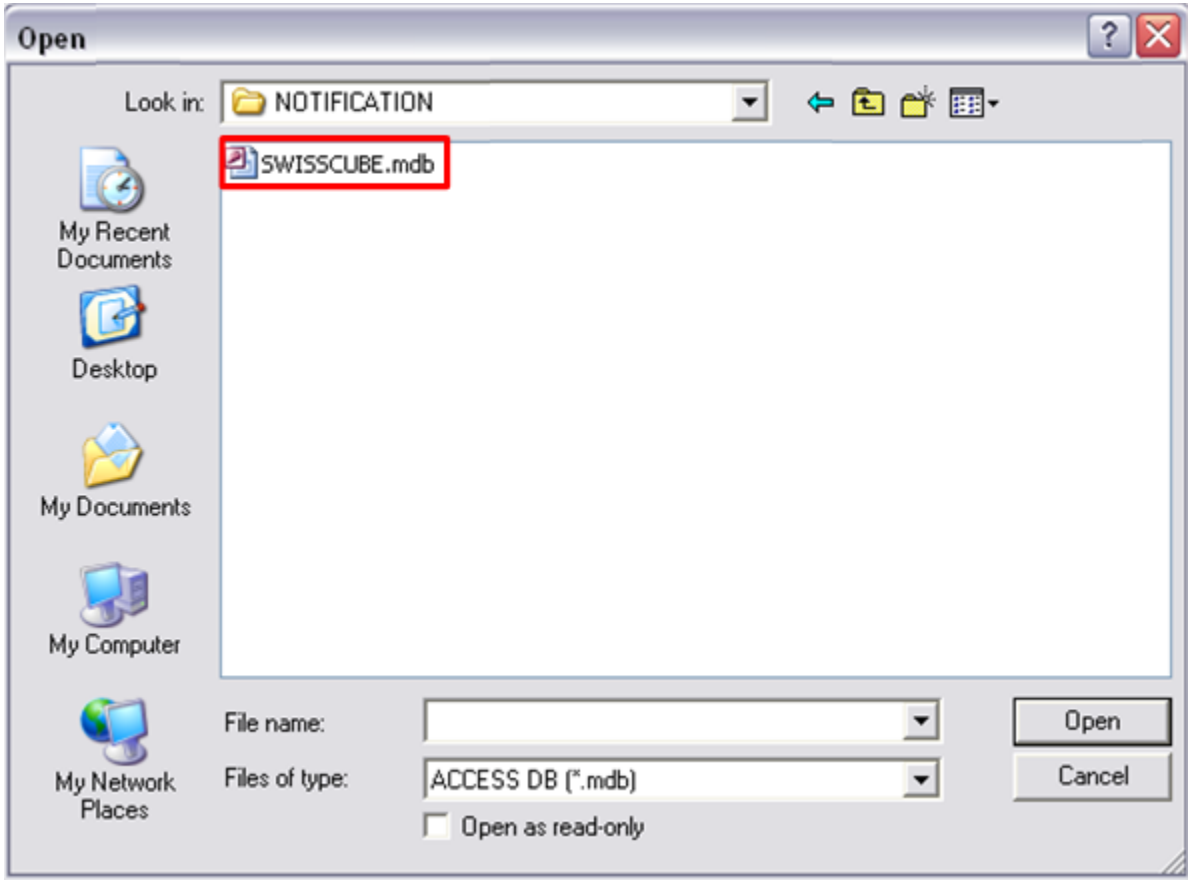


SELECT YOUR ACCESS DATABASE

STEP 2



SELECT ON YOUR HARD DISK
THE FILE CONTAINING YOUR CAPTURE



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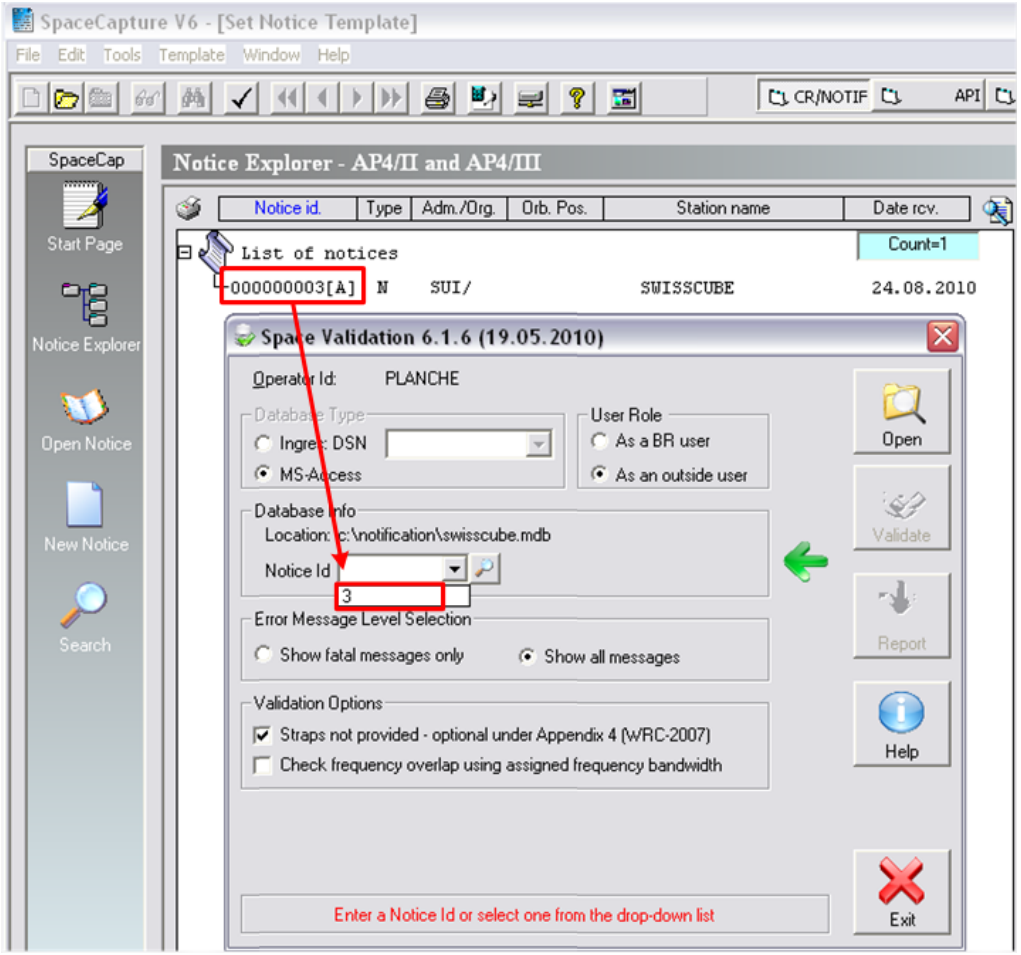
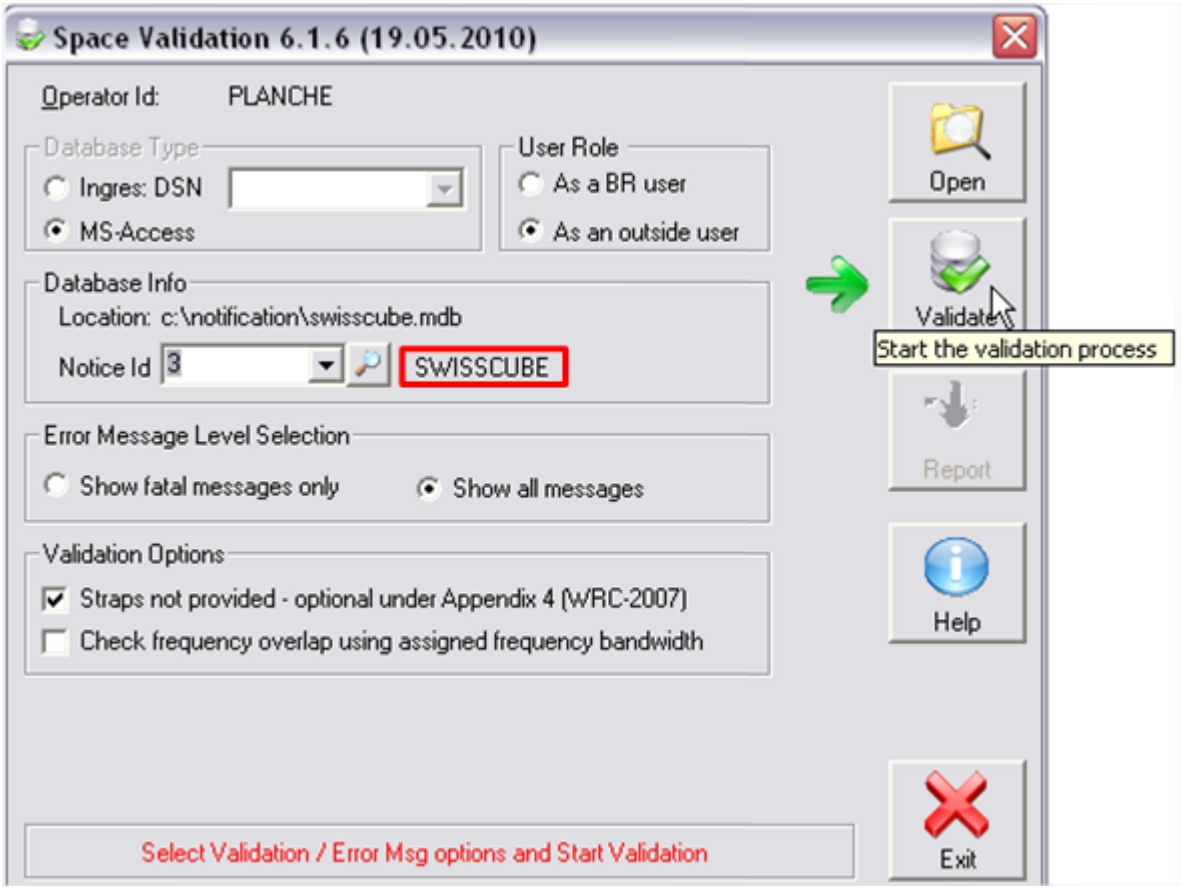


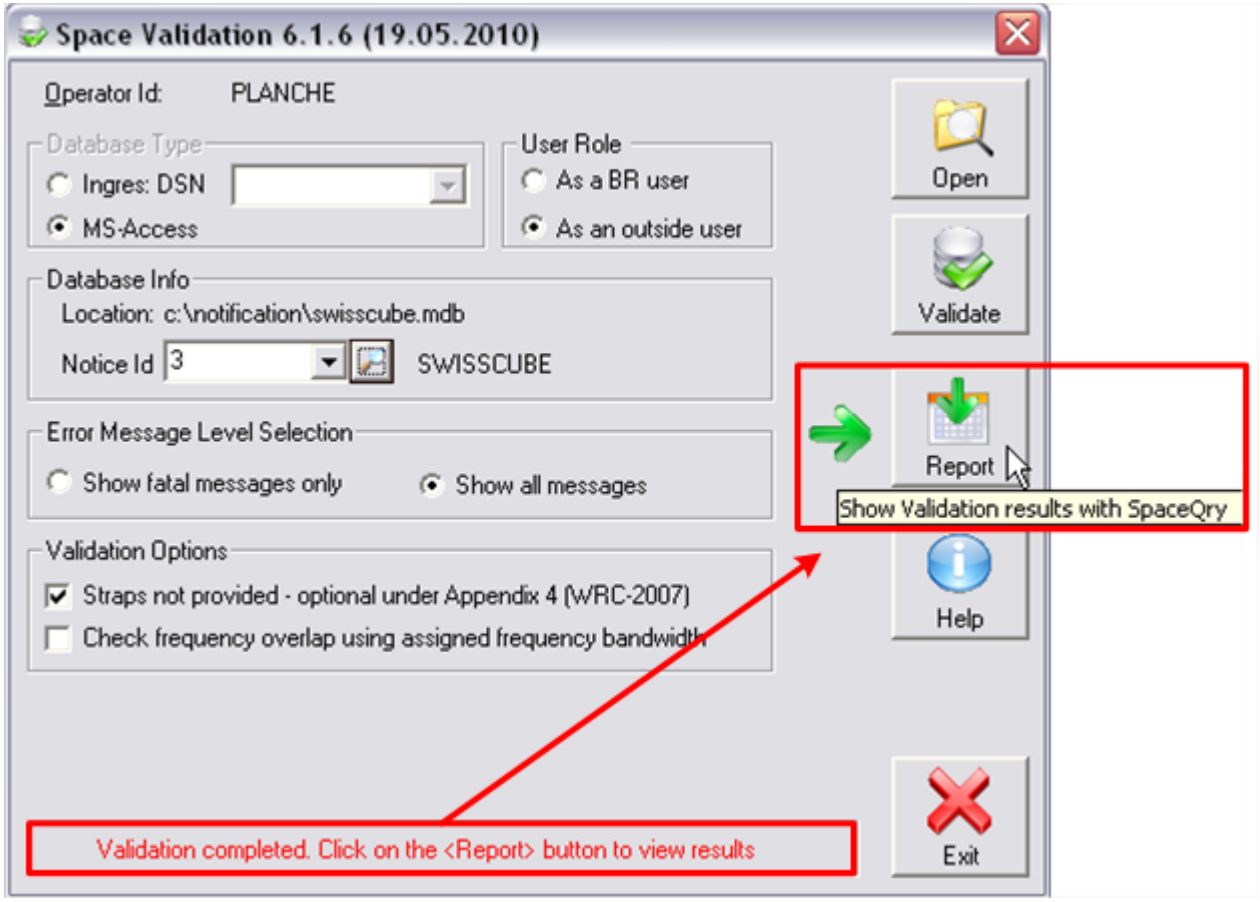
LAUNCH THE VALIDATION PROCESS

STEP 3

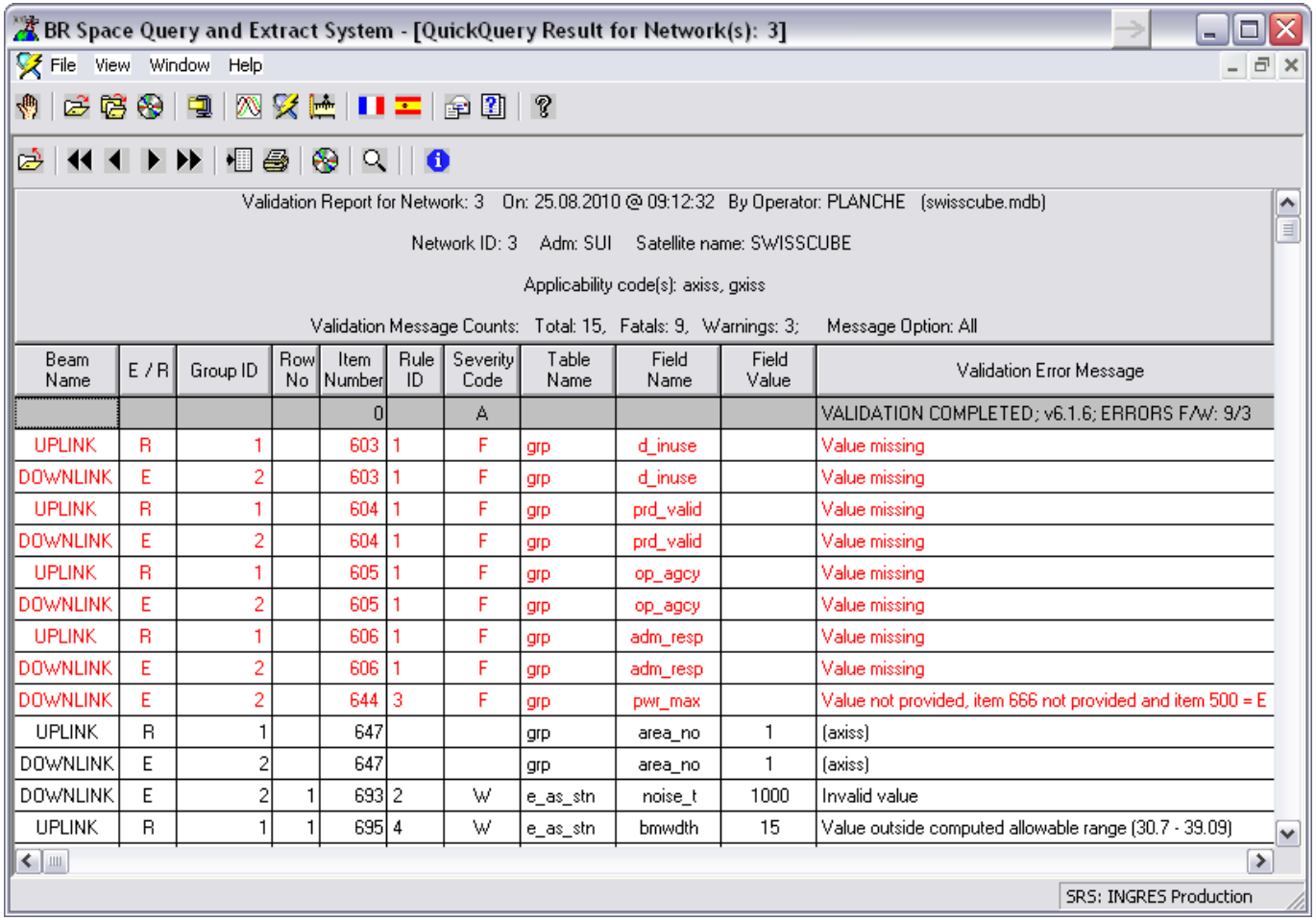


WHEN THE VALIDATION IS COMPLETED DISPLAY THE VALIDATION REPORT

STEP 4



PROCEED WITH ANALYZE AND CORRECTIONS



Beam Name	E / R	Group ID	Row No	Item Number	Rule ID	Severity Code	Table Name	Field Name	Field Value	Validation Error Message
				0		A				VALIDATION COMPLETED; v6.1.6; ERRORS F/W: 9/3
UPLINK	R	1		603	1	F	grp	d_inuse		Value missing
DOWNLINK	E	2		603	1	F	grp	d_inuse		Value missing
UPLINK	R	1		604	1	F	grp	prd_valid		Value missing
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UPLINK	R	1		605	1	F	grp	op_agcy		Value missing
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UPLINK	R	1		606	1	F	grp	adm_resp		Value missing
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DOWNLINK	E	2	1	693	2	W	e_as_stn	noise_t	1000	Invalid value
UPLINK	R	1	1	695	4	W	e_as_stn	bmwdth	15	Value outside computed allowable range (30.7 - 39.09)

How to submit a filing to the Bureau?

- Administrations may submit electronic filings to the Bureau on a **CD-ROM or as email file attachement** (zipped)

- Each Directory/Folder or zipped file should then contain the following files, as appropriate, for that particular network:

  – One **Network_Name/Station_Name.mdb** file in the SNS file format (this file should contain only ONE network !!)

  – One or several files for the submission of graphical data, notes on the diagrams in English only

  – One **Network_Name/Station_Name.doc** file (for any comments pertaining to the network)

Before you submit….

- Run Spaceval to ensure that there are no fatal errors
- If there are fatal errors, try to correct them before submission.
- If you are unable to get rid of the fatal errors, you can describe them in the cover letter of your submission, the Bureau will provide assistance to address the errors
- Make sure that all required antenna patterns are provided, either by formula or diagrams.
- Change extension of .mdb to .itu if there is a problem with your email server
- ***Satellite filings must be submitted by the Administration*.**

Other things to note

- Filing should be sent by email to BRMAIL@ITU.INT
- Filing must be confirmed by a fax (no. +41 (22) 730 5785) from an Administration within 7 days
- 7-year limit to bringing into use and submission of notification, otherwise API will be cancelled, and the entire filing process need to be restarted
- Cost recovery
  - No cost recovery fee for amateur satellite service
  - For all other services, containing assignments that are not subject to coordination
    - 570 CHF for API
    - 7030 CHF for Notifications
  - One free entitlement per year for each Administration

Regulatory procedures for comments and resolution of difficulties

- Commenting procedures
  - Comments to an API/A should be submitted within 4 months of API (No.**9.3**)
  - Comments to be captured using SPACECOM (**RES-55**)
  - The Bureau publishes the list of administrations which have sent comments in an API/B special section
- Resolution of difficulties
  - Both administrations shall endeavour to cooperate in joint efforts to resolve any difficulties and shall exchange any additional relevant information that may be available
  - *Either party can request for the assistance of the Radiocommunication Bureau (No.**9.3**)*
  - In case of difficulties, the administration responsible for the planned satellite network shall explore all possible means to resolve the difficulties without considering the possibility of adjustment to networks of other administrations
  - If no such means can be found, it may request the other administrations to explore all possible means to meet its requirements.
  - The administrations concerned shall make every possible effort to resolve the difficulties by means of mutually acceptable adjustments to their networks.

Modification of characteristics

- According to No.**9.2**, the only change for NGSO filing that requires a new API would be additional frequency band.

- However, it is a good practice to submit a modification to the API any change in characteristics including orbital characteristics, service area (adding earth stations) etc.

- This will allow other administrations/operators the chance to submit comments before the modifications are notified for recording in the Master Register.

Changes by WRC-12

- The World Radiocommunication Conference (WRC-12) was held in Geneva, Switzerland from 22 January – 17 February 2012

- Among the WRC-12 decisions that affect NGSO filing procedures No. **9.2**:
  - A new API would be required if
    - The reference body of the space station is changed
    - The direction of transmission is changed
  - New **AP4**data element **B.2bis.a** to indicate whether the assignment will be used for continuous/non-continuous transmission *(space station only transmits when visible from notified service area)*

For more information

- BR space website (http://www.itu.int/en/ITU-R/space)
- SNL online: http://www.itu.int/ITU-R/space/snl/index.html
- SNS online - TIES account required, need to be an ITU member (member state, ITU-R sector member, associate or academia) - http://www.itu.int/sns/
- BR IFIC on DVD-ROM
- BR IFIC Annual collection
- ITU Radio Regulations (RR)
- Rules of Procedure (RoP)
- ITU publications:
  - Handbook for earth exploration satellite service
  - Handbook for amateur and amateur-satellite services
- Workshop CD-ROM

Conclusions

- *Registration of frequency assignments with the ITU for small satellites is an obligation of the Administration under the treaty agreement of the Radio Regulations.*
- This will facilitate a harmonized and coordinated environment for which radio frequency is used on a global basis, minimizing the potential for any harmful interference.
- The Radiocommunication Bureau can provide assistance to operators/administrations to achieve the objective of getting their small satellite missions registered, recognized and protected in the Master Register.
- BR space website (http://www.itu.int/en/ITU-R/space) for more information .

Contacts

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  - Email: attila.matas@itu.int
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  - Email: chuen-chern.loo@itu.int
  - Tel: 41-22-7305339