OVERVIEW BR Space Applications for Non-Planned Services

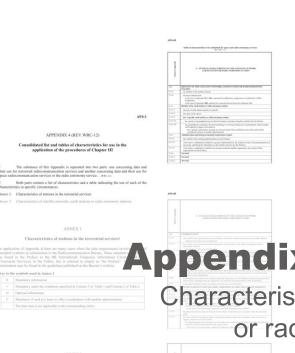
Hon Fai Ng

Space Services Department



APPENDIX 4 (REV.WRC-12) ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations² (Rev.WRC-12)



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Appendix 4 of Radio Regulations

Characteristics of satellite networks, earth stations or radio astronomy stations (Annex 2)

Key to the symbols used in Tables A. B. C and D

X	Mandatory information
+	Mandatory under the conditions specified in Column 2
0	Optional information
С	Mandatory if used as a basis to effect coordination with another administration
	The data item is not applicable to the corresponding notice

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APPENDIX 8 (REV.WRC-03)

Method of calculation for determining if coordination is required between geostationary-satellite networks sharing the same frequency bands

- T: the equivalent satellite link noise temperature, referred to the output of the receiving antenna of the earth station (K);
- T_s: the receiving system noise temperature of the space station, referred to the output of the receiving antenna of the space station (K);
- T_e : the receiving system noise temperature of the earth station, referred to the output of the receiving antenna of the earth station (K):
- ΔT_x: apparent increase in the receiving system noise temperature of the satellite S, caused by an interfering emission, referred to the output of the receiving antenna of this satellite (K);
- ΔT_e : apparent increase in the receiving system noise temperature of the earth station e_R, caused by an interfering emission, referred to the output of the receiving antenna of this station (K);

- θ_g: geocentric angular separation in degrees between the two satellites, taking the longitudinal station-keeping tolerances into account;
 - NOTE Only the geocentric angle $\theta_{\rm g}$ should be used in dealing with Case II.
- $g_1(\theta_t)$: transmitting antenna gain of the earth station e_T in the direction of satellite S' (numerical power ratio);
- $g_4(\theta_t)$: receiving antenna gain of the earth station e_R in the direction of satellite S' (numerical power ratio);
- Boltzmann's constant (1.38 × 10⁻²³ J/K);
- I_d: free-space transmission loss² on the downlink (numerical power ratio), evaluated from satellite S to the receiving earth station e_B for satellite link A;

 $d_s = 84\,332\,\sin\frac{\theta_g}{2}$ km

 $L = 20 (\log f + \log d) + 32.45$

 $d = 42.644 \sqrt{1 - 0.2954 \cos \psi}$

NOTE - The free-space transmission loss on any downlink evaluated from the satellites S or S' to the receiving

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Method of calculation for determining if coordination is required between

arrection, from satellities, of the receiving earth station e_g of satellite link A;

for 48° ≤ φ <180°

NOTE — The product p_g g₁(s₁) is the maximum e₁xp₁ p₂ Guestin colling to the maximum e₁xp₂ p₃ Guestin colling to the maximum e₁xp₃ p₄ Guestin colling to the maximum e₁xp₄ p₅ Guestin colling to the maximum e₁xp₅ p₅ Guestin colling to the maximum e₁

- n.': direction, from satellite S, of satellite S':
- p_e: maximum power density per Hz delivered to the antenna of the transmitting earth station e_T (averaged over the worst 4 kHz band for a carrier frequency below 15 GHz or over the worst 1 MHz band above 15 GHz) (WHz);
- $g_2(\delta)$: receiving antenna gain of satellite S in the direction δ (numerical power ratio);
- 5_A: direction, from satellite S, of the transmitting earth station e_T of satellite link A:
- $\delta_{e'}$: direction, from satellite S, of the transmitting earth station e'_{T} of satellite link A';
- $\delta_{s'}$: direction, from satellite S, of satellite S';
- θ_t: topocentric angular separation in degrees between the two satellites¹, taking the longitudinal station-keeping tolerances into account;
 - NOTE Only the topocentric angle θ_{r} should be used in dealing with Case I.

$$\Delta T_s = \frac{p_e' g_1'(\theta_t) g_2(\delta_{e'})}{b_t}$$

$$\Delta T_e = \frac{p_s' g_3'(\eta_e)g_4(\theta_t)}{t} \tag{2}$$

$$\Delta T = \gamma \frac{p'_e g'_1(\theta_t) g_2(\delta_{e'})}{kl_{.t}} + \Delta T_e = \frac{p'_s g'_3(\eta_e) g_4(\theta_t)}{kl_{.t}}$$
(4)

$$\Delta T' = \gamma \frac{p_e g_1(\theta_t) g_2'(\delta_e)}{k l_J} + \Delta T_e = \frac{p_s g_3(\eta_{e'}) g_4'(\theta_t)}{k l_J}$$
(7)

$$\Delta T' = \gamma' \Delta T'_s = \frac{\gamma' p_s g_3(\eta_{s'}) g'_2(\delta_s)}{k I_s} s$$
(10)

$$\theta_t = \arccos\left(\frac{d_1^2 + d_2^2 - \left(84.332 \sin \frac{\theta_g}{2}\right)^2}{2d_1 \cdot d_2}\right)$$

expressed in the same unit wavelength
$$\theta$$
 expressed in the same unit θ of θ . axis angle of the antenna, in degrees, equal to θ , or θ _B, as applicable θ . G1: gain of the first sidelobe = 2 + 15 log $\frac{D}{\lambda}$

$$\varphi_m = \frac{20 \, \lambda}{D} \, \sqrt{G_{max} - G_1}$$
 degrees $\varphi_r = 15.85 \left(\frac{D}{\lambda}\right)^{-0.6}$ degrees

b) for values of $\frac{D}{\lambda}$ < 100 ⁴ (maximum gain < 48 dB approximately):

$$G(\varphi) = G_{max} - 2.5 \times 10^{-3} \left(\frac{D}{\lambda} \varphi\right)^2$$
 for $0 < \varphi < \varphi_m$
 $G(\varphi) = G_1$ for $\varphi_m \le \varphi < 100 \frac{\lambda}{-}$

$$\phi$$
) = G_1 for $\phi_m \le \phi < 100 \frac{\kappa}{D}$

$$G(\varphi) = 52 - 10 \log \frac{D}{\lambda} - 25 \log \varphi$$
 for $100 \frac{\lambda}{D} \le \varphi < 48^\circ$

$$G(\varphi) = -10 - 10 \log \frac{D}{\lambda}$$
 for $48^{\circ} \le \varphi \le 18$

USE OF BR SPACE APPLICATIONS HELPS

Provides guidance to apply and comply with Radio Regulations





BR Space Applications aim to be

Efficient



- Maximum productivity with minimum effort
- Structured and logical approach
- Quick results

BR Space Applications aim to be

Efficient Reliable



- Comply with Radio Regulations
- Maintained by developers and engineers
- Used by administrations and operators

BR Space Applications aim to be

Efficient Reliable Consistent



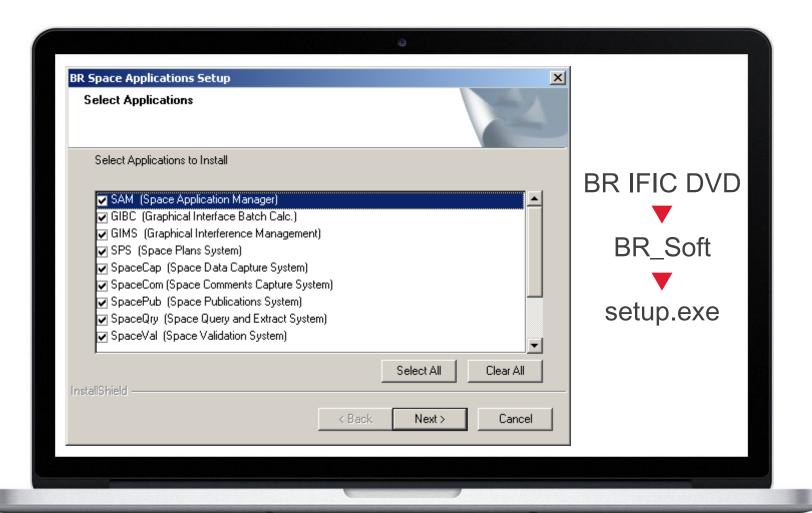
- Repeatability of results
- Interoperability between BR space applications

BR Software is

FREE

ITU BR software webpage BR IFIC DVD*

* 1 free per administration else CHF600/DVD or CHF3530/year



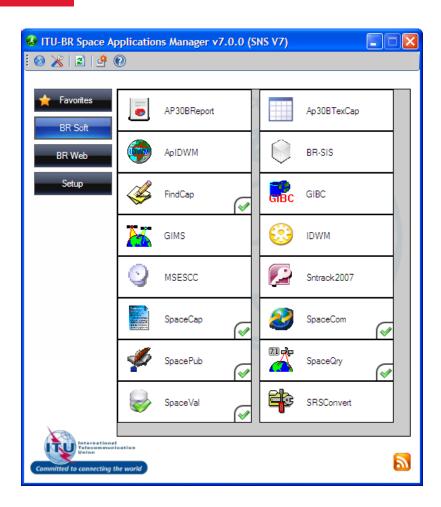
VERSION 7

Latest version, incorporated changes from WRC-12



Space Applications Manager

ONE
INTERFACE
to launch BR software

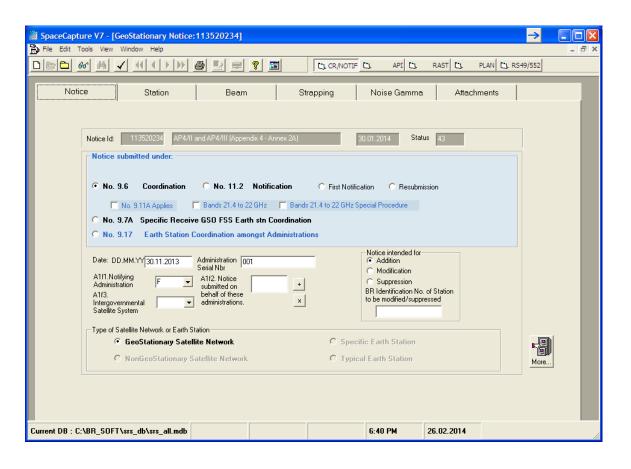


Space Applications Manager

SpaceCap

CAPTURE NOTICES

Captures data in SNS-structured Access database for electronic submission of notices relating to space stations: API, Coordination Requests, Notification, Resolution 49/552



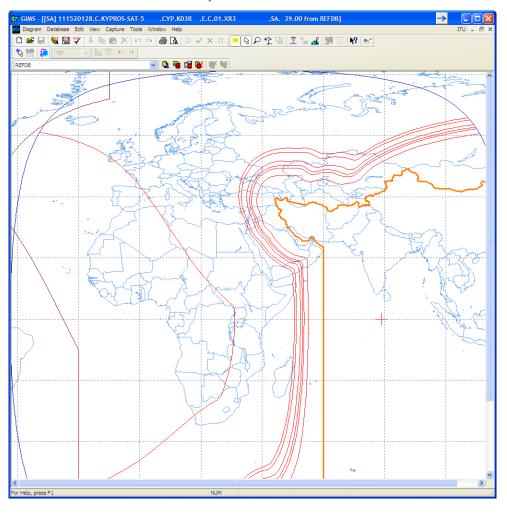
Space Applications Manager

SpaceCap

GIMS

GRAPHICAL DATA CAPTURE

Captures or view service areas, antenna gain contours and gain towards GSO orbit relating to GSO satellite networks; perform calculations



Space Applications Manager

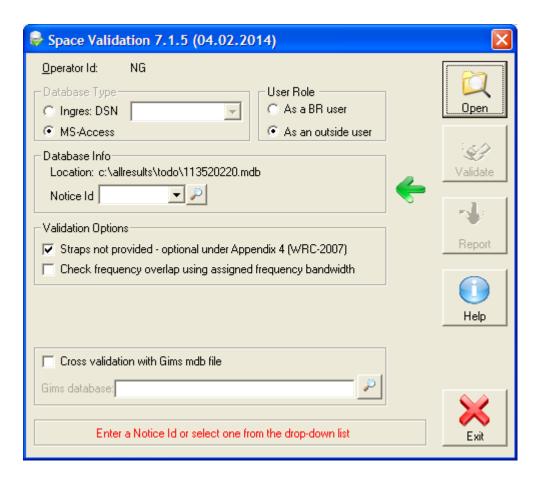
VALIDATION

Checks for errors and completeness before submitting electronic notices to BR

SpaceCap

GIMS

SpaceVal



Space Applications Manager

PUBLICATION

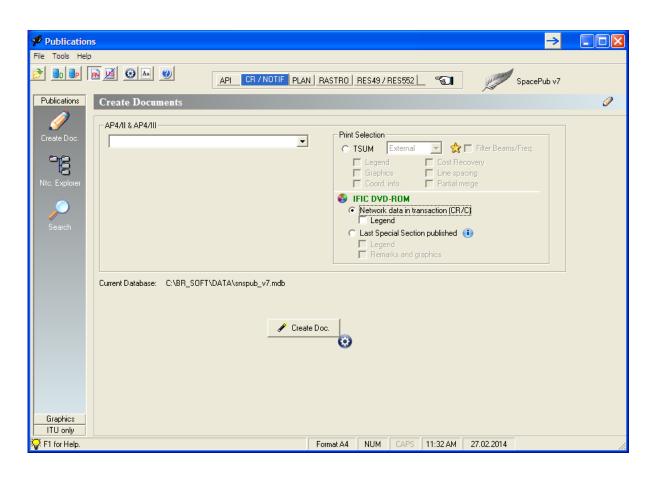
Extracts data from SNS-structured Access database and creates rich-text document suitable for printing or reading

SpaceCap

GIMS

SpaceVal

SpacePub



Space Applications Manager

SpaceCap

GIMS

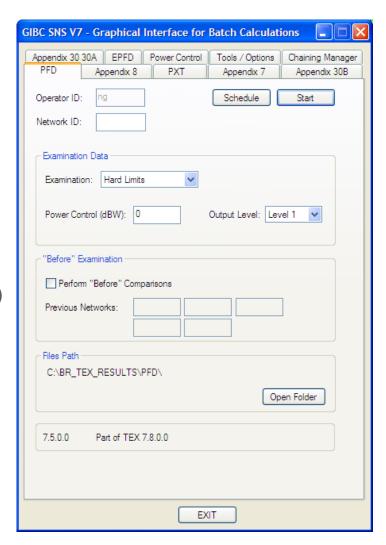
SpaceVal

SpacePub

GIBC

BATCH CALCULATION

Determines PFD/EIRP hard limits and coordination requirements GSO vs GSO (9.7, 9.21/A, 9.41) GSO vs Plans (Ap30#7.1, Ap30A#7.1) GSO vs Terrestrial (9.11, 9.14, 9.21/C)



Space Applications Manager

SpaceCap

GIMS

SpaceVal

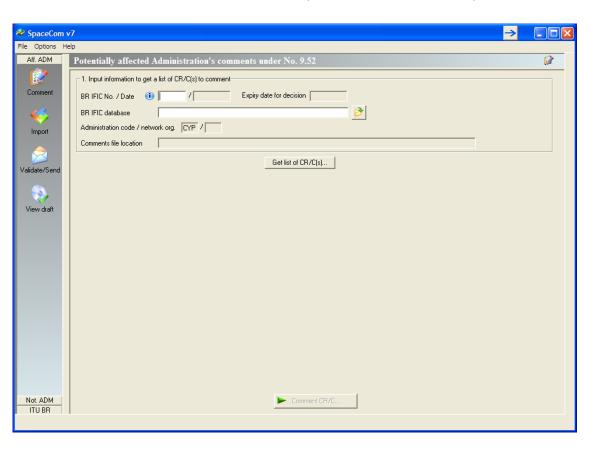
SpacePub

GIBC

SpaceCom

COMMENTS/ OBJECTIONS

Manages comments and objections from Administrations covering provisions Nos. 9.41 and 9.52 (9.11, 9.11A, 9.21)



Space Applications Manager

QUERY

Finds and retrieves information about networks from SNS-structured Access database

SpaceCap

GIMS

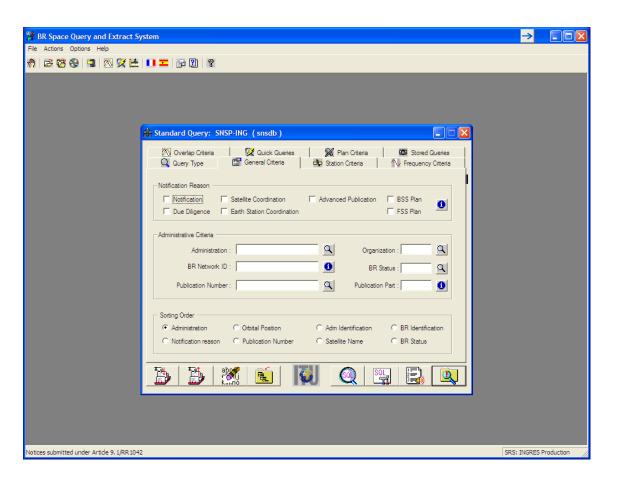
SpaceVal

SpacePub

GIBC

SpaceCom

SpaceQry



Space Applications Manager

SpaceCap



GIMS



SpaceVal



SpacePub



GIBC



SpaceCom



SpaceQry



SAM Space Applications Manager

BR Databases

SpaceCap



GIMS



SpaceVal



SpacePub



GIBC

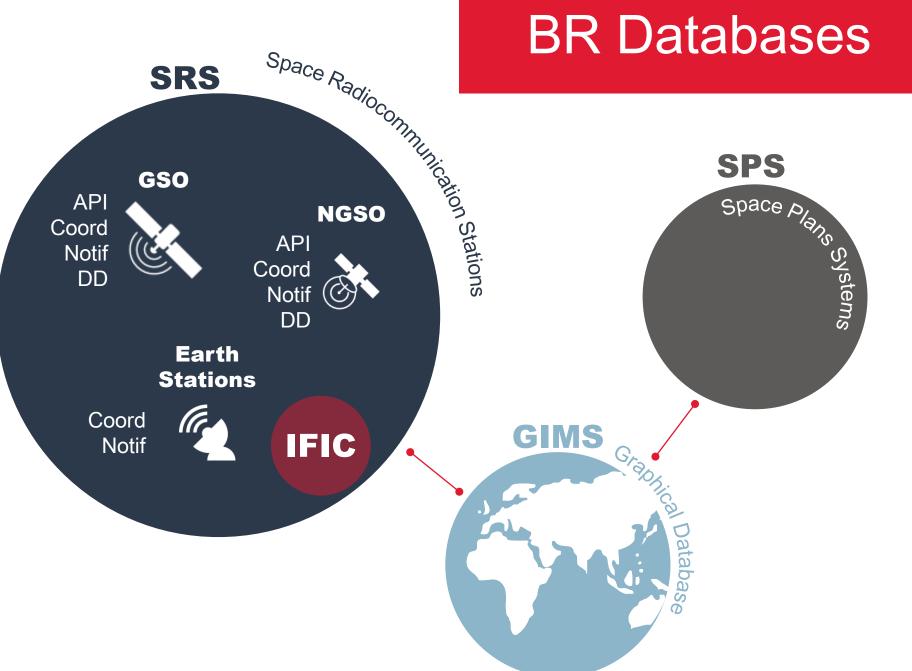


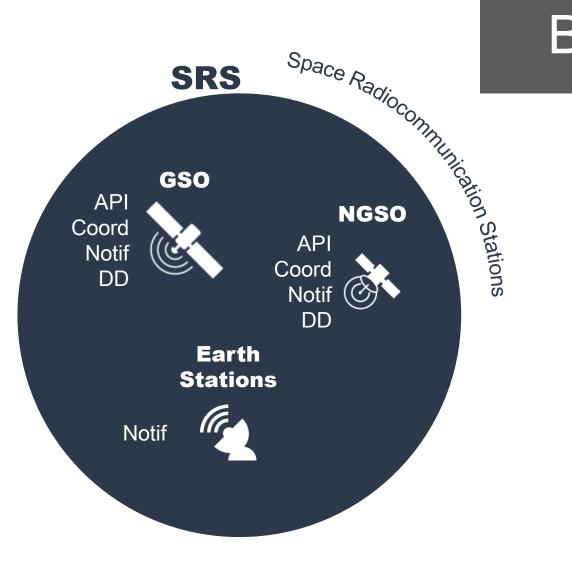
SpaceCom



SpaceQry







SRS

SPACE RADIOCOMMUNICATION STATIONS

- Important database
- Available in BR IFIC DVD
- Contains alphanumeric data of ALL satellite networks and Earth stations
- API, Coordination Requests, Due Diligence, Notification, Recorded in MIFR
- Snapshot of Master Database at production time of BR IFIC

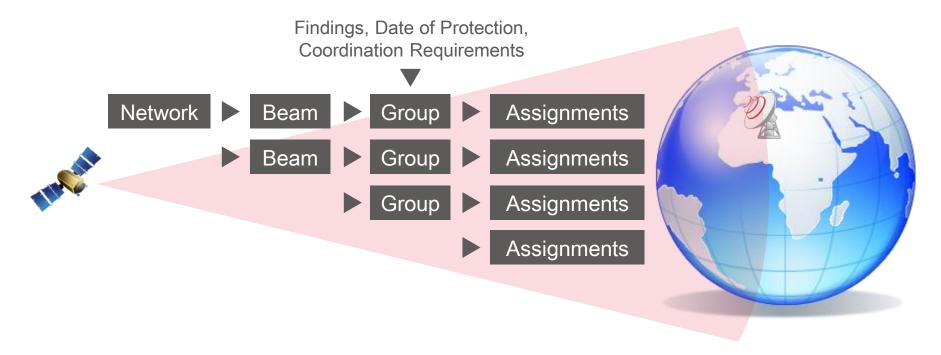
SpaceCap or SpaceQry for browsing SpacePub for printing GIBC for examination

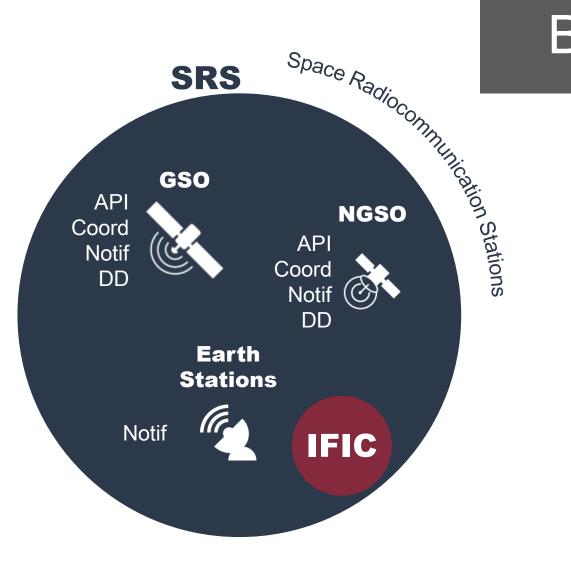
SRS

SPACE RADIOCOMMUNICATION STATIONS

Structure based on Appendix 4, Annex 2 (SNS-structured Access database)
Has 70+ tables and almost 2 GB

SRS





SRS

IFIC

INTERNATIONAL FREQUENCY INFORMATION CIRCULAR



- SRS
- **IFIC**

- Available in BR IFIC DVD and SNS Space IFIC webpage
- Contains alphanumeric data of satellite networks and Earth stations currently published in BR IFIC
- Same structure as SRS

SpaceCap or SpaceQry for browsing SpacePub for printing SpaceCom for commenting



SRS

IFIC

GIMS

GRAPHICAL DATABASE

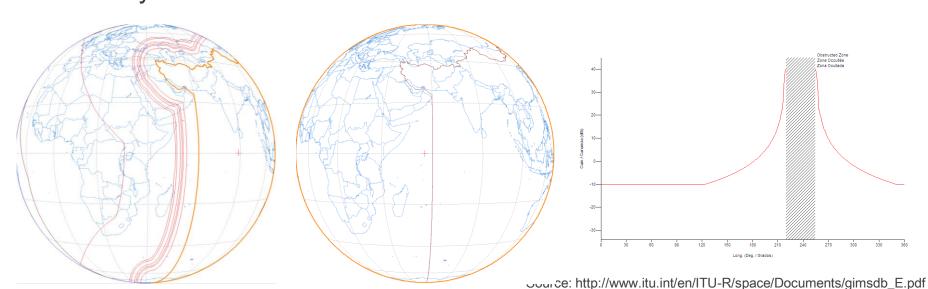
- Available in BR IFIC DVD
- Contains graphical data of ALL satellite networks
- Almost 700 MB

GIMS software for browsing Needed by GIBC for examination

SRS

IFIC

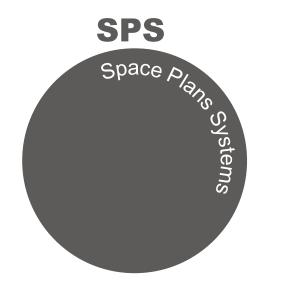
GIMS



SPACE PLANS DATABASE

- Available in BR IFIC DVD
- Contains data for Ap30/30A Plans

Needed by GIBC for coordination requirements



SRS

IFIC

GIMS

SPS

DRAFT CR/D DATABASE

- Available in BR IFIC DVD
- Merged comments from potentially affected administrations received by BR under Nos. 9.11, 9.11A and 9.21

Notifying administration to validate SpaceCom for viewing or validating SRS

IFIC

GIMS

SPS

Draft CR/D

REFERENCE DATABASE

- Available in BR IFIC DVD and SpaceRefdb webpage
- Contains reference tables for BR Software

SRS

IFIC

GIMS

SPS

Draft CR/D

SpaceRef

SAM Space Applications Manager

BR Databases

SpaceCap

GIMS

SpaceVal

SpacePub

GIBC

SpaceCom

SpaceQry



SRS

IFIC

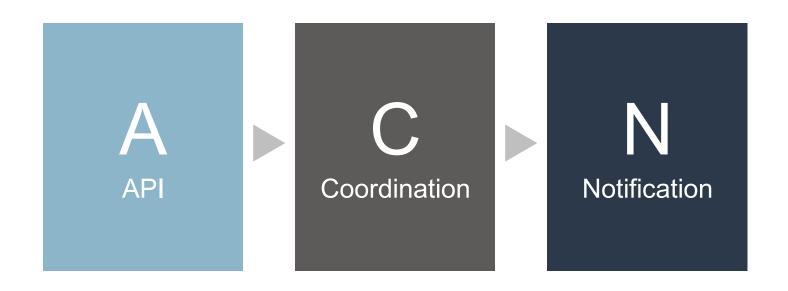
GIMS

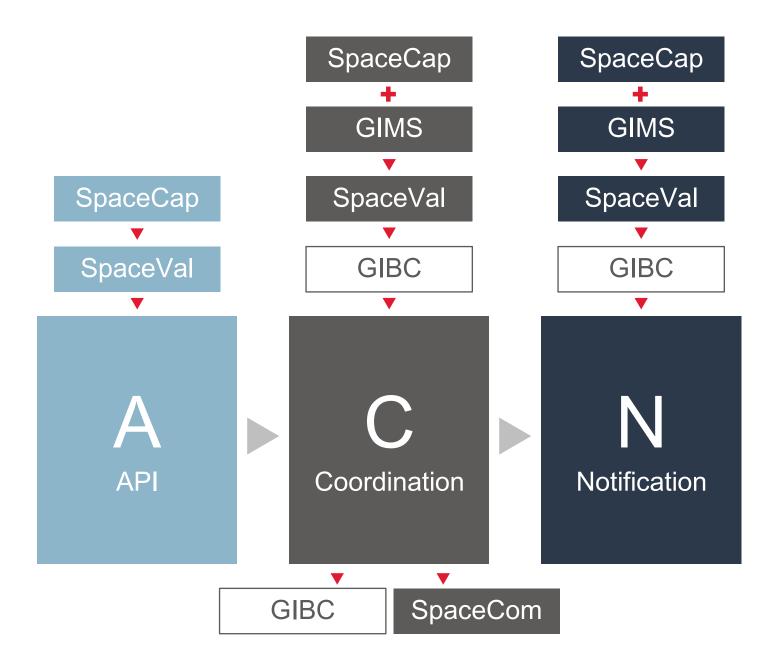
SPS

Draft CR/D

SpaceRef

TYPICAL SCENARIO





SAM Space Applications Manager

BR Databases

SpaceCap

GIMS

SpaceVal

SpacePub

GIBC

SpaceCom

SpaceQry



SRS

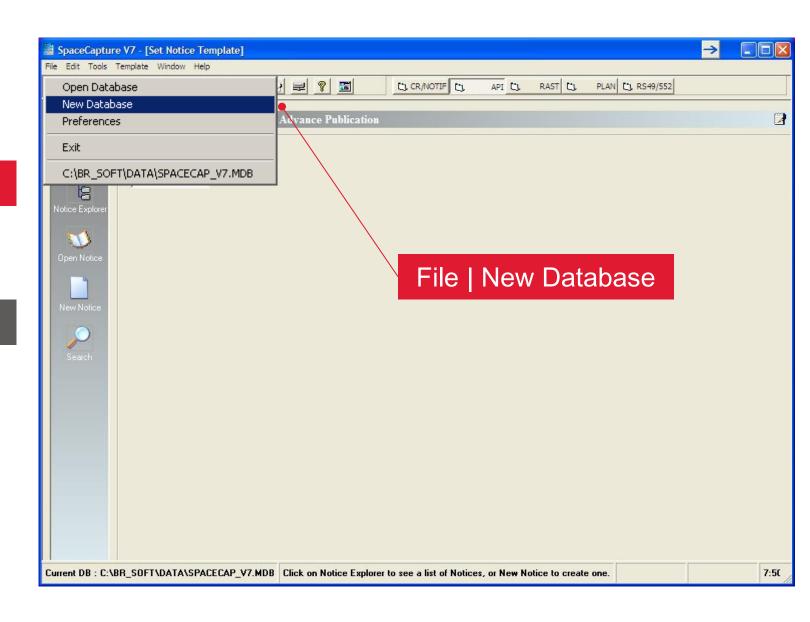
IFIC

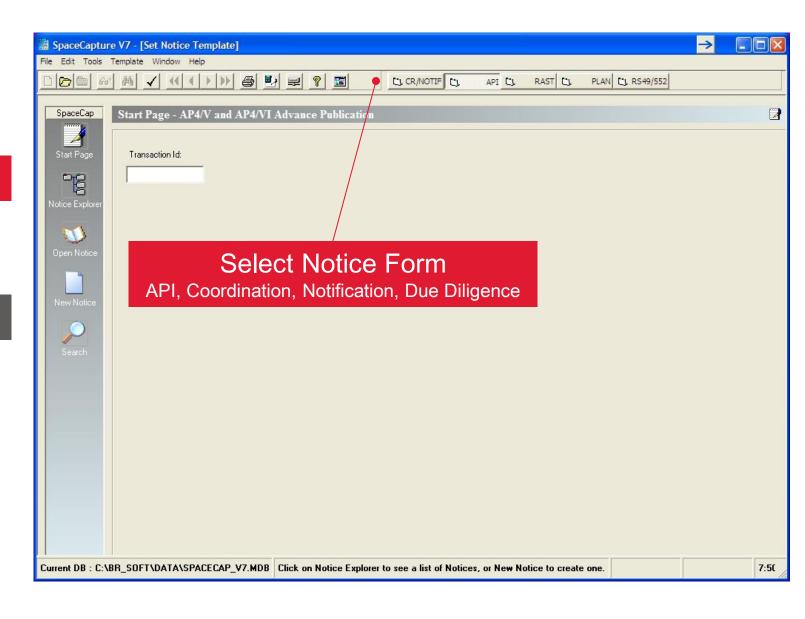
GIMS

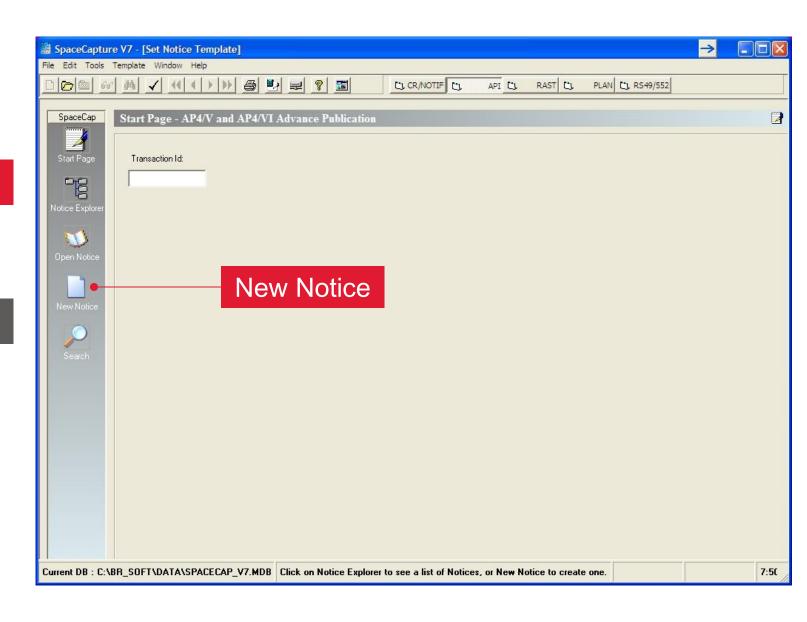
SPS

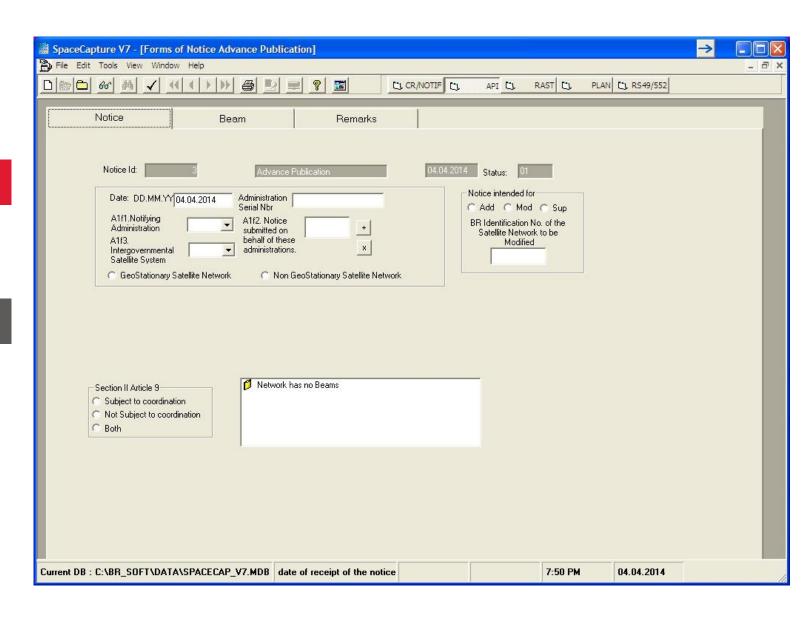
Draft CR/D

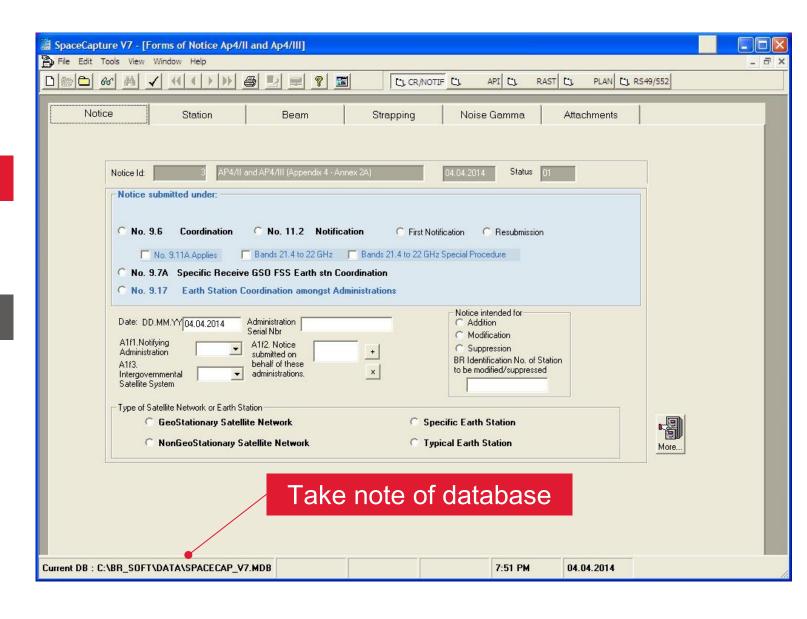
SpaceRef









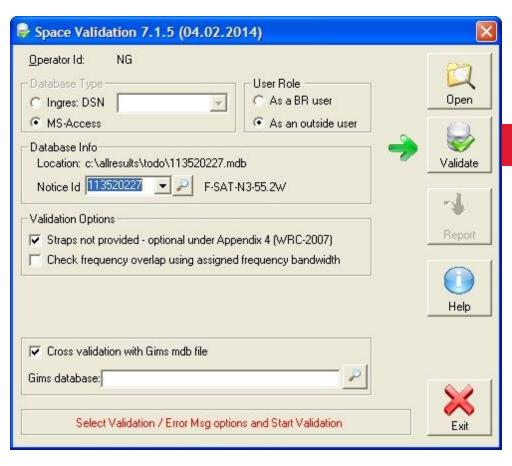


SpaceVal



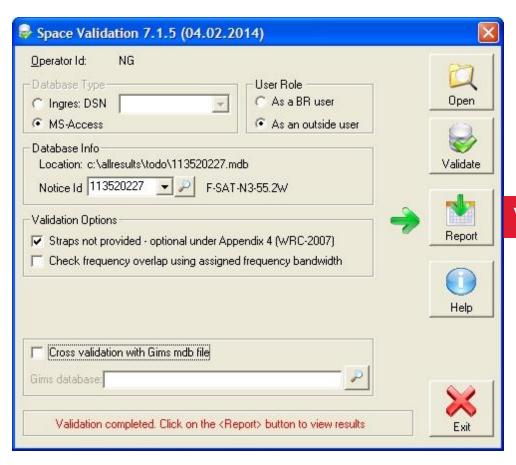
Open database

SpaceVal

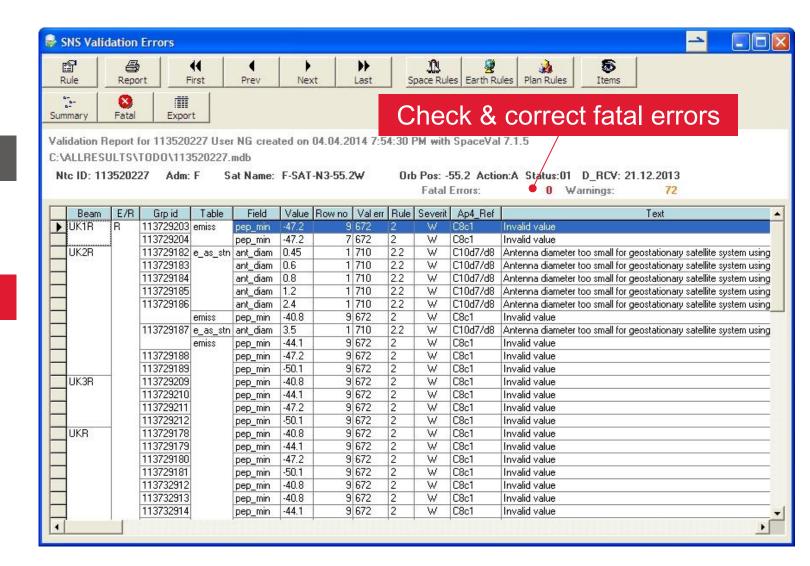


Click Validate

SpaceVal



View Report





- Validated database with no fatal errors
- Send mail/fax (+41 22 730 57 85) confirmation within 7 days



FINAL POINTS

- Install from BR IFIC DVD or website
- Use databases of latest BR IFIC DVD
- Get help from ITU BR Seminar webpage or brsas@itu.int

OVERVIEW BR Space Applications for Non-Planned Services

Hon Fai Ng

Space Services Department

