GIBC (PFD) WORKSHOP
DO THIS NOW!

1. Run GIBC V8
2. Select PFD (Terrestrial) tab
3. Enter Network 116520121
4. Click Start

Space Workshop GIBC (PFD) Exercises

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Radiocommunication Bureau (BR)

54%

Satellite networks in 2016 have unfavourable findings
No status & no date of protection
New submission incurs cost & new date of protection

However, unfavourable findings can be easily eliminated

2931
GSO Satellite Networks

453
Non-GSO Satellite Systems

Aim to operate in an **Interference Free** environment

Potential for interference

1.93 million
Terrestrial

Interference Control Mechanism

Allocation
Frequency separation of different services
(Article 5)

Regulatory Protection
"Not to cause harmful interference or claim protection"
(Articles 5 & 22)

Power Limits
Power-Flux Density (PFD) to protect TERR services
EIRP to protect SPACE services
EPFD to protect GSO from NGSO
(Articles 5, 21 & 22)

Coordination
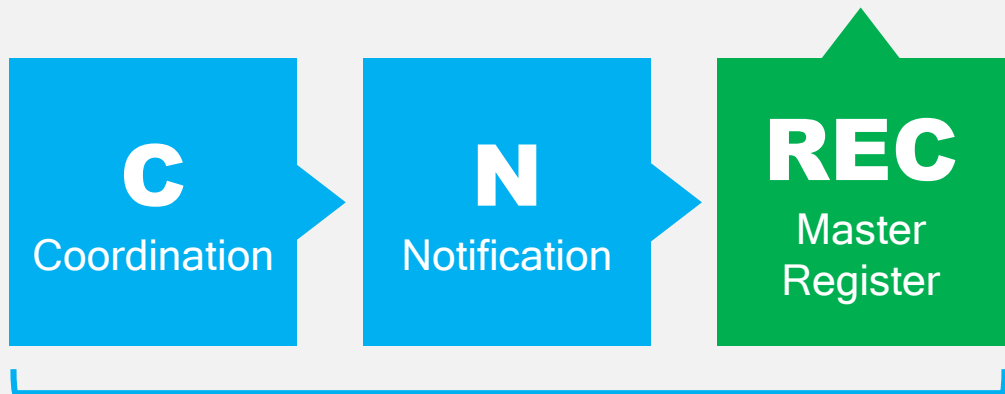between Administrations to ensure interference-free operations conditions
(Article 9)

C Coordination → **N** Notification → **REC** Master Register

7y

Right to international recognition, taken into account to avoid harmful interference (No. 8.3)
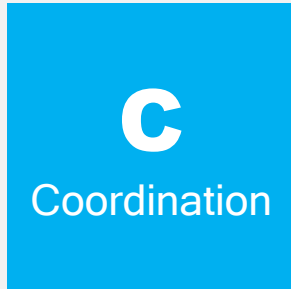
Favourable or Unfavourable

C
Coordination

1. Findings

Conformity with Table of Frequency Allocation &
other provisions (PFD/EIRP Limits etc.)
(Nos. 9.35, 11.31 of RR, RoP11.31)

2. Coordination Requirements

Identify any administration with which coordination
may need to be effected
(Nos. 9.36, 9.36.1, 9.36.2)

OPEN PFD.LST (use Notepad)

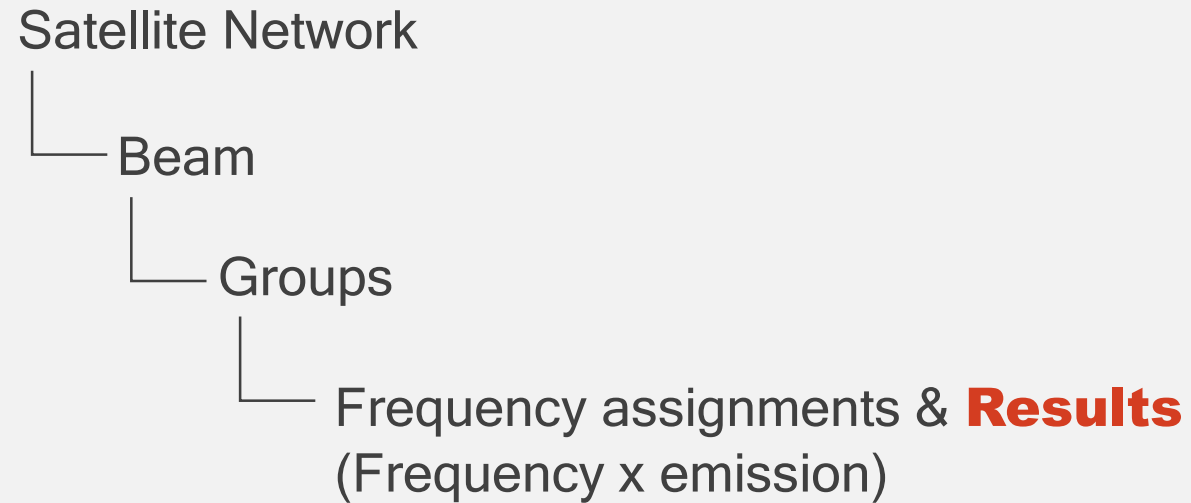C:\BR_TEX_RESULTS\PFD\116520121\<timestamp>
OR
<USB Key>
\Space_Workshops...\09-Coordination...\PFD\PFD Hard Sample 1.LST
OR
www.itu.int/en/ITU-R/space/Pages/wrs2016SpaceWorkshop.aspx

PFD.LST STRUCTURE

Satellite Network

└── Beam

└── Groups

└── Frequency assignments & **Results**
(Frequency x emission)

PFD.LST (HARD LIMITS)

Beam name   Maximum Gain   Group ID


```
KTR                        34.00 DB        POINTING ACC  0.10 DEG                                    116.520121
EK ER          250000 KHZ DR 12.05.16                                                        N-     116.677596
11.07500 G        250000 KHZ  4K00N0N--   -8.00 DBW    -44.00 DBW/HZ                          N-      0001
         ( 6) RR 21.16             FIXED-SATELLITE                        REF. BW  0.004MHZ
         ALL WORLD                               159E5242   53N5410   RUS      34.00 -137.27   12.73 -150.00     N-
EK ER          250000 KHZ DR 12.05.16                                                        N-     116.677597
11.57500 G        250000 KHZ  4K00N0N--   -8.00 DBW    -44.00 DBW/HZ                          N-      0001
         ( 6) RR 21.16             FIXED-SATELLITE                        REF. BW  0.004MHZ
         ALL WORLD                               159E5242   53N5410   RUS      34.00 -137.27   12.73 -150.00     N-
EK ER          250000 KHZ DR 12.05.16                                                        N-     116.677598
12.62500 G        250000 KHZ  4K00N0N--   -8.00 DBW    -44.00 DBW/HZ                          N-      0001
         ( 7) RR 21.16             FIXED-SATELLITE                        REF. BW  0.004MHZ
         REGION 1 CTYS OF 5.494 AND 5.496 AND REGION 3    017E1611   07N4932   TCD      34.00 -137.27   10.73 -148.00     N-
```

Ref. to applicable limits | Worst case location
e.g. 21.16, 5.503, 21.13A, 22.40 (WRC-15), 5.509C (WRC-15) etc.

Frequency assignment with excess
(Frequency | Bandwidth | Emission | Total Peak Power | Maximum Power Density)

Gain | PFD at worst case | Max Excess | PFD Limit | Ref BW

CASE STUDY

Satellite name: GSAT-NS(93.5E)
Notice ID: 116520121
Orbital Longitude: 93.5°E
Frequency Bands: Ku-band
Services: FSS
Special Section: CR/C/4091
BR IFIC: 2832 / 08.11.2016

QUESTION 1/7

The GIBC (PFD) program can be used for:

ANSWER

a. Both GSO and Non-GSO satellite networks/systems

✅ b. GSO satellite networks only

GIBC (PFD) only works for GSO!

Assuming KTR3S is a <u>fixed</u> beam, what would be the finding of emission 29M6G7F--?

KTR3S		34.00 DB	POINTING ACC	0.10 DEG		
EC	40000 KHZ DP 12.05.16				A-	116.677654
12.22000 G	40000 KHZ	29M6G7F--	20.50 DBW	-53.40 DBW/HZ	N-	0001
(7) RR 21.16	FIXED-SATELLITE				REF. BW	0.004MHZ
REGION 3		169E0421	18S3827 VUT	34.00 -146.65	1.35 -148.00	N-

ANSWER

a. Favourable

✓ b. Unfavourable

Because PFD limit is exceeded!
To resolve, reduce maximum power density, total peak power or transmit gain of satellite by excess value

For **steerable** beams, if frequency assignments exceed PFD hard limits (space-to-Earth), what are the conditions for a favourable finding?

ANSWER

a) At least one position of the beam where PFD limits are met without reduction of power density

b) Administration states that PFD limits will be met by applying a method submitted to BR

"B3b1b Method in An1 RoP21.16" check box in SpaceCap

✔ c) All of the above (a + b)

d) None of the above, PFD limits must be met at all positions

See Rules of Procedures on No. 21.16

v8

STEERABLE BEAM

Formula
Power Flux-Density, **PFD**
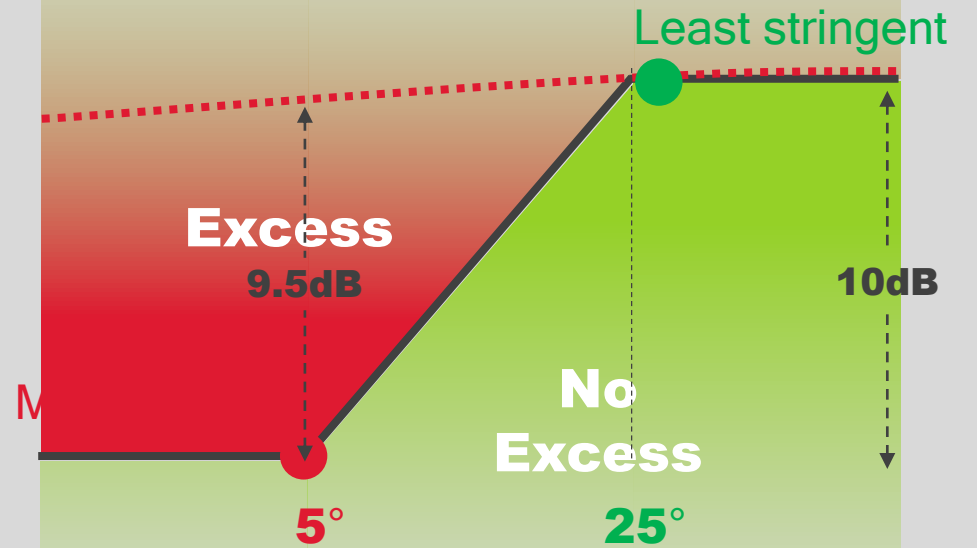$= PD_{max} + 10\log(BW_{ref}) + G(\theta) - 10\log(4\pi R^2) \; dB(W/m^2)$

R

R is shorter,
PFD is higher

Worst case
Most stringent

Best case
Least stringent

5°

~25°

Typical PFD Limits Curve
Table 21-4 of Article 21
e.g. C, Ku, Ka-bands FSS GSO*

Least stringent

Excess
9.5dB

10dB

M

No Excess

5°   25°

General Rule: For globally steerable beam with worst case location at 5° elevation, max tolerable excess is **9.5 dB**

Assuming KTR3S is a globally **steerable** beam, what would be the finding of emission 29M6G7F--?

```
KTR3S                      34.00 DB     POINTING ACC  0.10 DEG
EC            40000 KHZ DP 12.05.16                |                            A-    116.677654

  12.22000 G      40000 KHZ  29M6G7F--  20.50 DBW  -53.40 DBW/HZ               N-    0001

             ( 7) RR 21.16           FIXED-SATELLITE                     REF. BW  0.004MHZ
             REGION 3                   169E0421  18S3827  VUT   34.00 -146.65  1.35 -148.00   N-
```

ANSWER
✓ a. Favourable
   b. Unfavourable

Worst case location is at 5 deg elevation angle & Administration provided a method to meet PFD hard limits to BR

Within tolerable excess

QUESTION 6/7

Assuming KTR3S is a globally **steerable** beam, what would be the finding of emission 4K00N0N--?

```
KTR3S                        34.00 DB      POINTING ACC   0.10 DEG
EK ER          300000 KHZ DR 12.05.16                                        N-     116.677653

   12.35000 G       300000 KHZ  4K00N0N--  -8.00 DBW    -44.00 DBW/HZ         N-      0001

               ( 7) RR 21.16          FIXED-SATELLITE                   REF. BW  0.004MHZ
               REGION 3                      169E0421  18S3827  VUT   34.00 -137.27  10.73 -148.00    N-
```

ANSWER

a. Favourable

✔ b. **Unfavourable**

Worst case location is at 5 deg elevation angle & Administration provided a method to meet PFD hard limits to BR

Exceeds tolerable excess

QUESTION 7/7

What parameters will affect PFD (space-to-Earth) <u>excess</u>?

MULTIPLE ANSWERS

- ✅ • Maximum power density or total peak power
- ✅ • Satellite transmit gain
- ❌ • Earth station gain or antenna diameter
- ❌ • Earth station antenna pattern
- ✅ • Test point location
- ✅ • Frequency bands and service

Hard Limits vs Trigger
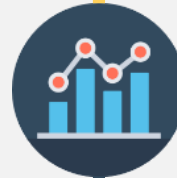
GIBC "Hard Limits" option

GIBC "Trigger" option

To establish findings

To establish coordination requirements

Excess = Unfavourable (except for steerable beams, conditions apply)

Excess = Coordination may be required, Adm needs to confirm

Provisions: 9.14, 9.11, 9.21/C

PFD.LST (TRIGGER) STRUCTURE

Satellite Network

└── Beam

       └── Groups

              └── Frequency assignments & **Results**
(Frequency x emission)

Contains list of **ALL** countries
where PFD trigger is exceeded

PFD.LST (TRIGGER)

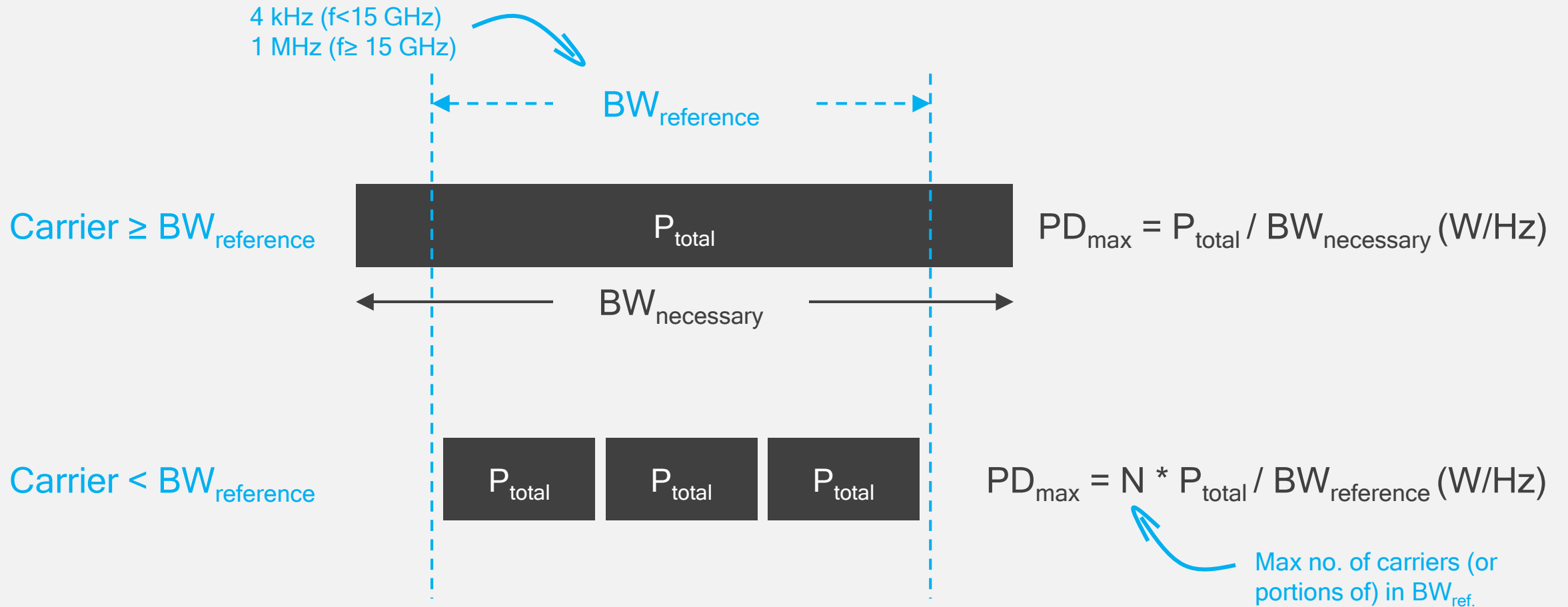<USB Key> .. PFD Trigger Sample.LST

```
CLCR                    42.0 DB    POINTING ACC  0.20 DEG                        116.520160

EI              9500 KHZ DR 26.05.16                                              116.683385

  1529.75000 M        9500 KHZ  1K00N0N--    4.0 DBW  -26.0 DBW/HZ                  A-   0001

        (51) RR 5.354          MOBILE-SATELLITE                          REF. BW   1.000MHZ
        REGIONS 1 AND 3                      099E43 07N13 THA     38.0 -121.3   6.7 -128.0    N-
AFS      1.1  AGL      1.9  ALG      0.7  ARS      0.8  AUS/HMD  2.4  AUS/ICO  5.5  BDI      1.9
BEN      1.2  BFA      0.9  BGD      4.1  BOT      1.7  BRM      6.7  BTN      4.1  CAF      1.9
CBG      6.7  CHN      6.7  CME      1.9  COD      1.9  COG      1.9  COM      1.1  CTI      0.6
DJI      1.3  DNK/FRO  1.8  EGY      1.2  ERI      1.5  ETH      1.9  F  /AMS  0.1  F  /KER  0.4
F  /MYT  0.8  F  /REU  0.6  FIN      3.7  G        0.5  GAB      1.9  GHA      1.0  GNE      1.9
IND      6.5  INS      6.7  ISL      5.6  KAZ      5.2  KEN      1.9  KGZ      1.7  LAO      6.7
LBY      1.5  LSO      0.3  MDG      0.7  MLA      6.7  MLI      0.8  MNG      6.7  MOZ      1.9
MWI      1.9  NGR      1.9  NIG      1.9  NMB      1.8  NOR      6.7  NPL      2.5  POR/AZR  0.4
RRW      1.9  RUS      6.7  S        3.2  SDN      1.9  SEY      0.9  SNG      6.6  SOM      1.8
SSD      1.9  STP      1.9  SWZ      0.6  TCD      1.9  TGO      1.1  THA      6.7  TZA      1.9
UGA      1.9  VTN      6.7  XZZ/XBY  1.9  YEM      1.0  ZMB      1.9  ZWE      1.9
```

List of **ALL** countries where PFD trigger is exceeded | PFD excess in the country

HOW TO DEFINE MAX POWER DENSITY

4 kHz (f<15 GHz)
1 MHz (f≥ 15 GHz)

$BW_{reference}$

Carrier ≥ $BW_{reference}$

P_{total}

$BW_{necessary}$

$PD_{max} = P_{total} / BW_{necessary}$ (W/Hz)

Carrier < $BW_{reference}$

P_{total} P_{total} P_{total}

$PD_{max} = N * P_{total} / BW_{reference}$ (W/Hz)

Max no. of carriers (or portions of) in $BW_{ref.}$

KEY POINTS

Use GIBC (Hard Limits)

Check applicable limits are not exceeded

Resolve before submitting to BR

Modify parameters & submit correct Max Power Density
For steerable beams, check "B3b1b Method in An1 RoP21.16"
Check (manually) conformity with Table of Frequency Allocation

Eliminate Unfavourable finding

To obtain date of protection