
Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [Above 6 GHz Frequency Plan Proposal for TG4a]

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Abstract: [Above 6 GHz frequency plan proposal for DS-UWB radios]

Purpose: [Proposal to harmonize some proposed frequency plans]

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Above 6 GHz Frequency Plan Proposal For TG4a

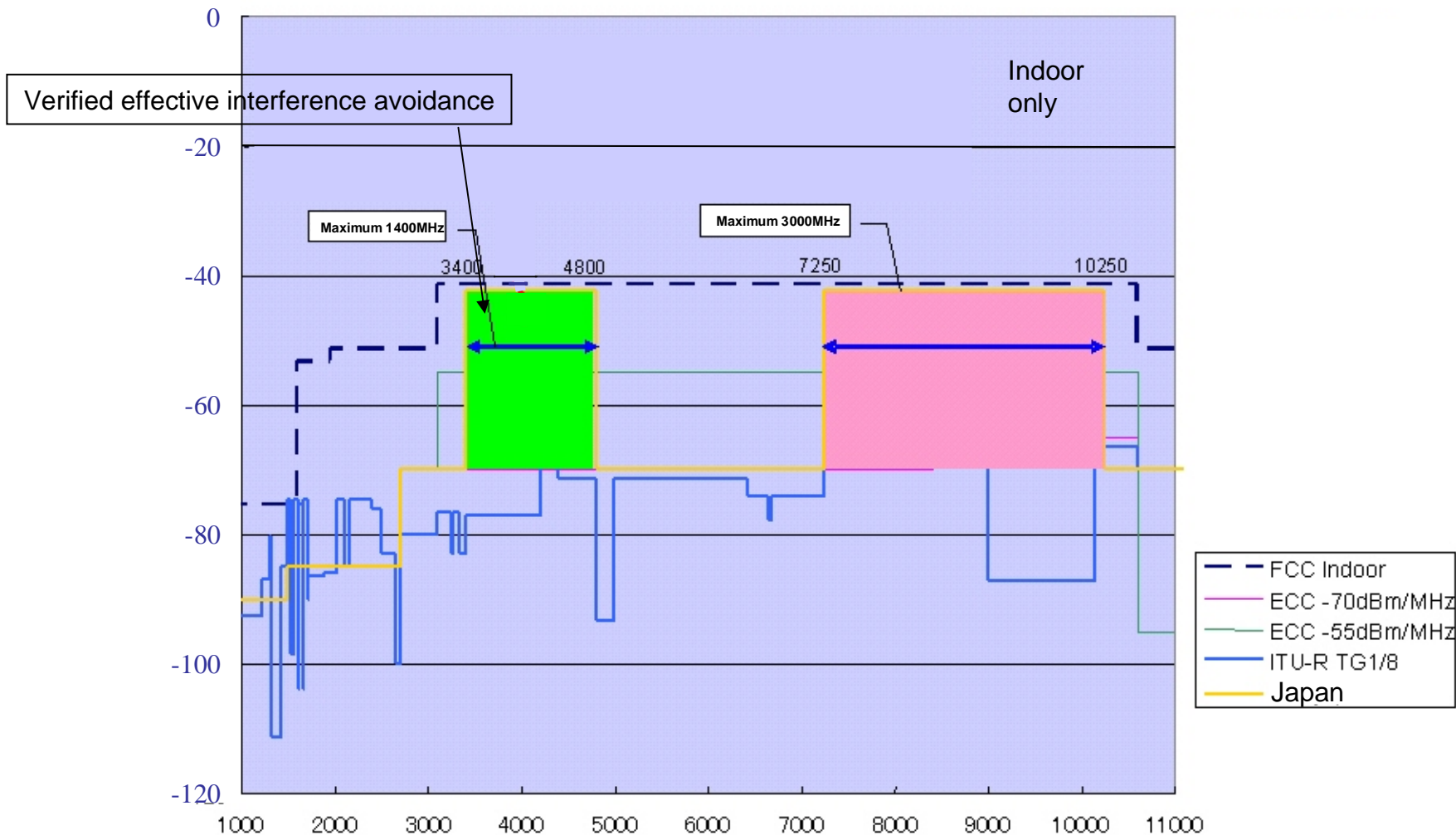
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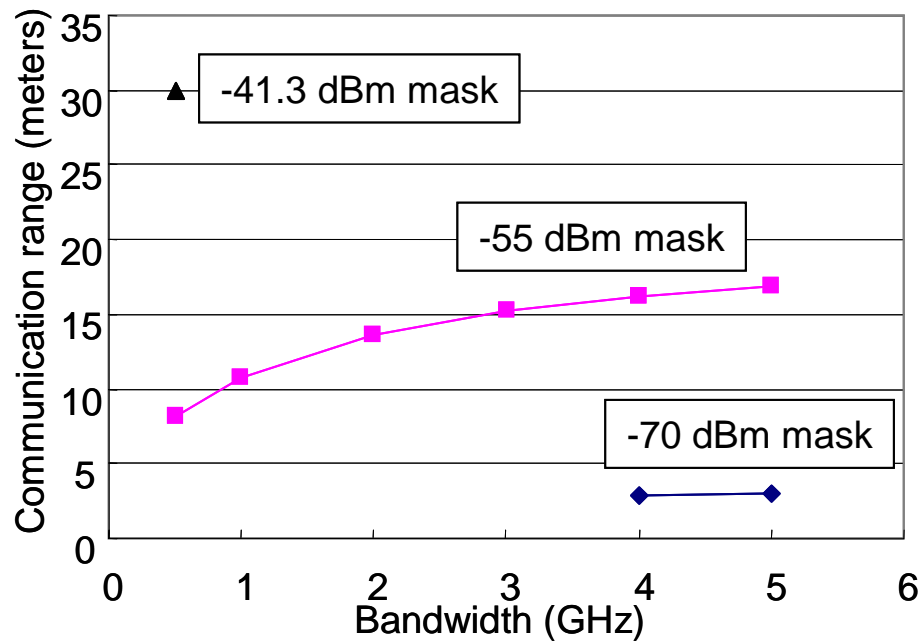
Motive For Above 6 GHz Plan

- Although discussed within TG4a (05-0389-02) but no show in the accepted band plan (05-0250-03).
- Attractive characteristics compared to low band (3.1 - 4.9 GHz)
 - More available frequency bandwidths.
 - Less interference systems.
- Above 6 GHz is becoming attractive as restriction on low band is increasing ...
 - Upcoming 4G systems (3.6 – 4.2 GHz and 4.4 -4.9 GHz)
 - Increasing restriction on UWB low band (ITU, Europe, Japan)

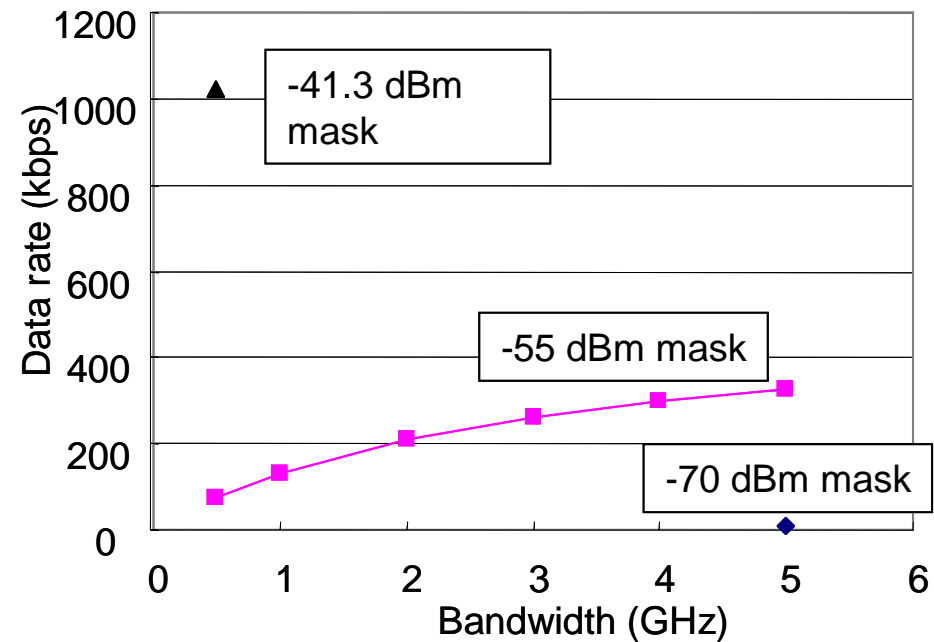
Draft Spectrum Mask in Japan



Effects of Low Spectrum Mask

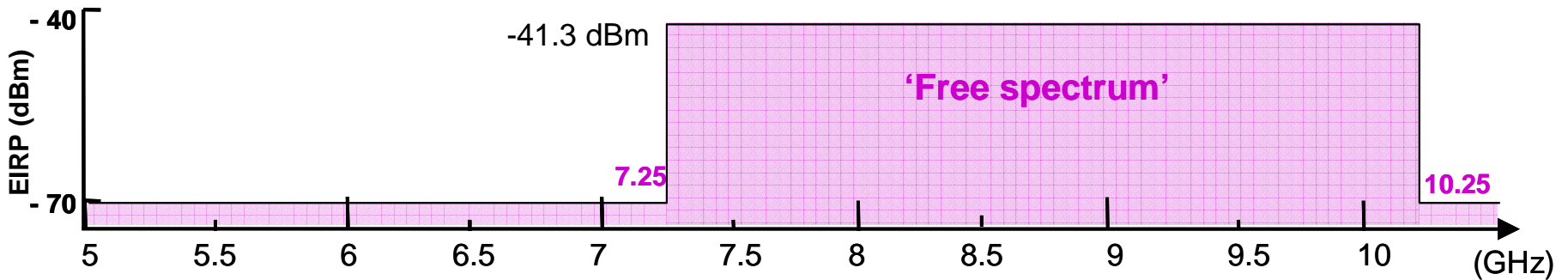


Communication Range

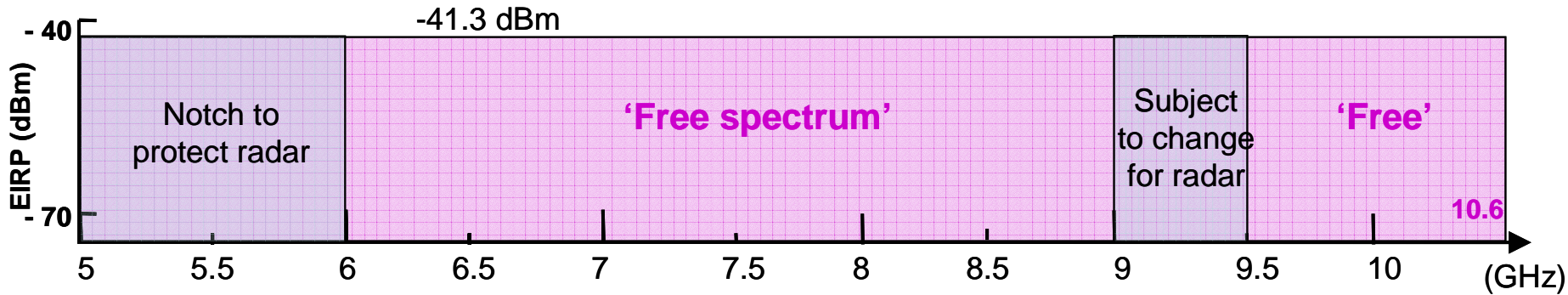


Data Rate

'Free Spectrum' Of Japan & OFCOM



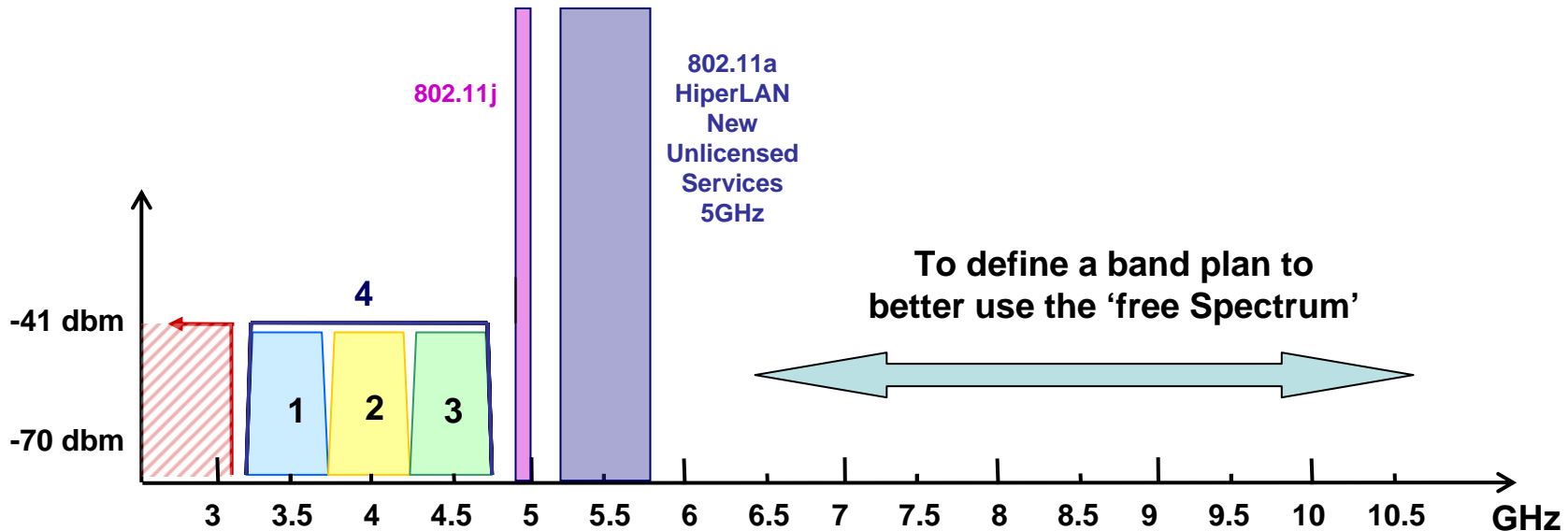
Draft spectrum mask in Japan



OFCOM's spectrum mask

The Accepted Band Plan

| Band No. | 3 dB BW (MHz) | Low Freq. (MHz) | Center Freq. (MHz) | High Freq. (MHz) |
|---------------|---------------|-----------------|--------------------|------------------|
| 1 | 494 | 3211 | 3458 | 3705 |
| 2 (mandatory) | 494 | 3705 | 3952 | 4199 |
| 3 | 494 | 4199 | 4446 | 4693 |
| 4 | 1482 | 3211 | 3952 | 4693 |



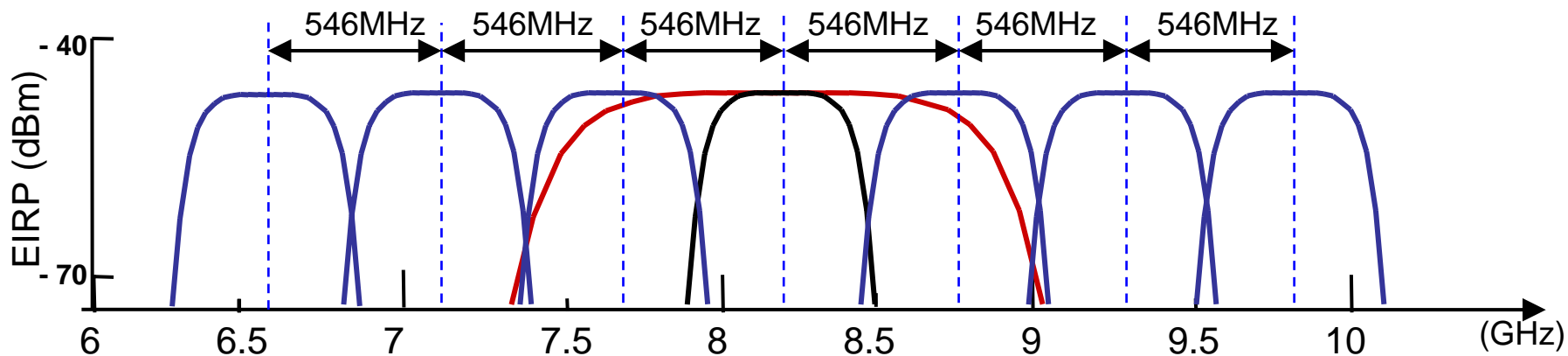
Attention To Pay On High Band Plan

- Center frequencies are integer product of PRF.
- Use as small possible prime factors.
- Harmonization with the accepted low band plan.
- Fit for proposed 'free spectrum mask'.

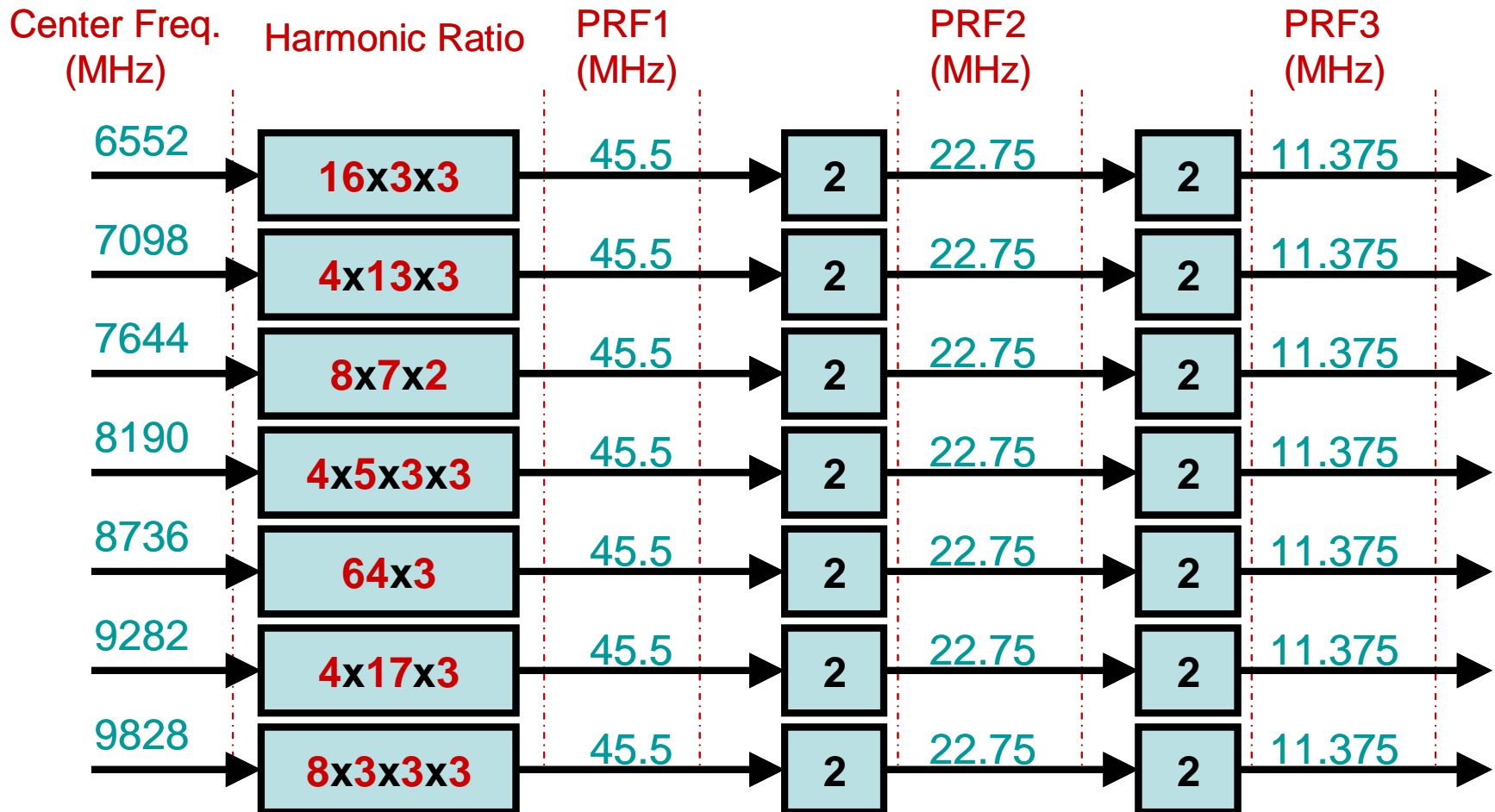
Above 6.1 GHz Proposal 1

Band Plan (I)

| Band No. | Bandwidth (MHz) | Low Freq. (MHz) | Center Freq. (MHz) | High Freq. (MHz) |
|---------------|-----------------|-----------------|--------------------|------------------|
| 1 | ~546 | 6279 | 6552 | 6825 |
| 2 | ~546 | 6825 | 7098 | 7371 |
| 3 | ~546 | 7371 | 7644 | 7917 |
| 4 (mandatory) | ~546 | 7917 | 8190 | 8463 |
| 5 | ~546 | 8463 | 8736 | 9009 |
| 6 | ~546 | 9009 | 9282 | 9555 |
| 7 | ~546 | 9555 | 9828 | 10101 |
| 8 | ~1600 | 7390 | 8190 | 8990 |

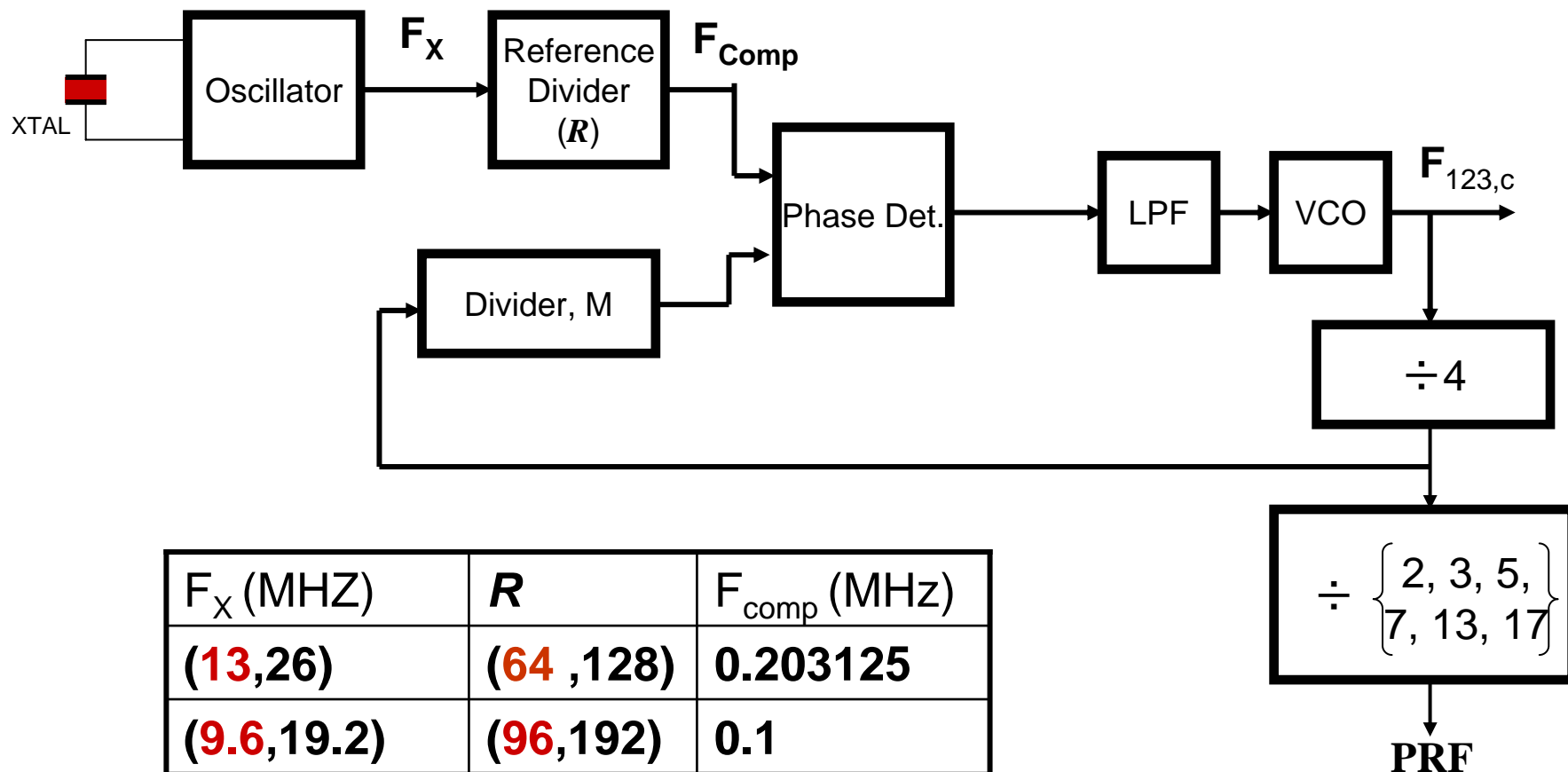


PRF Generation (I)



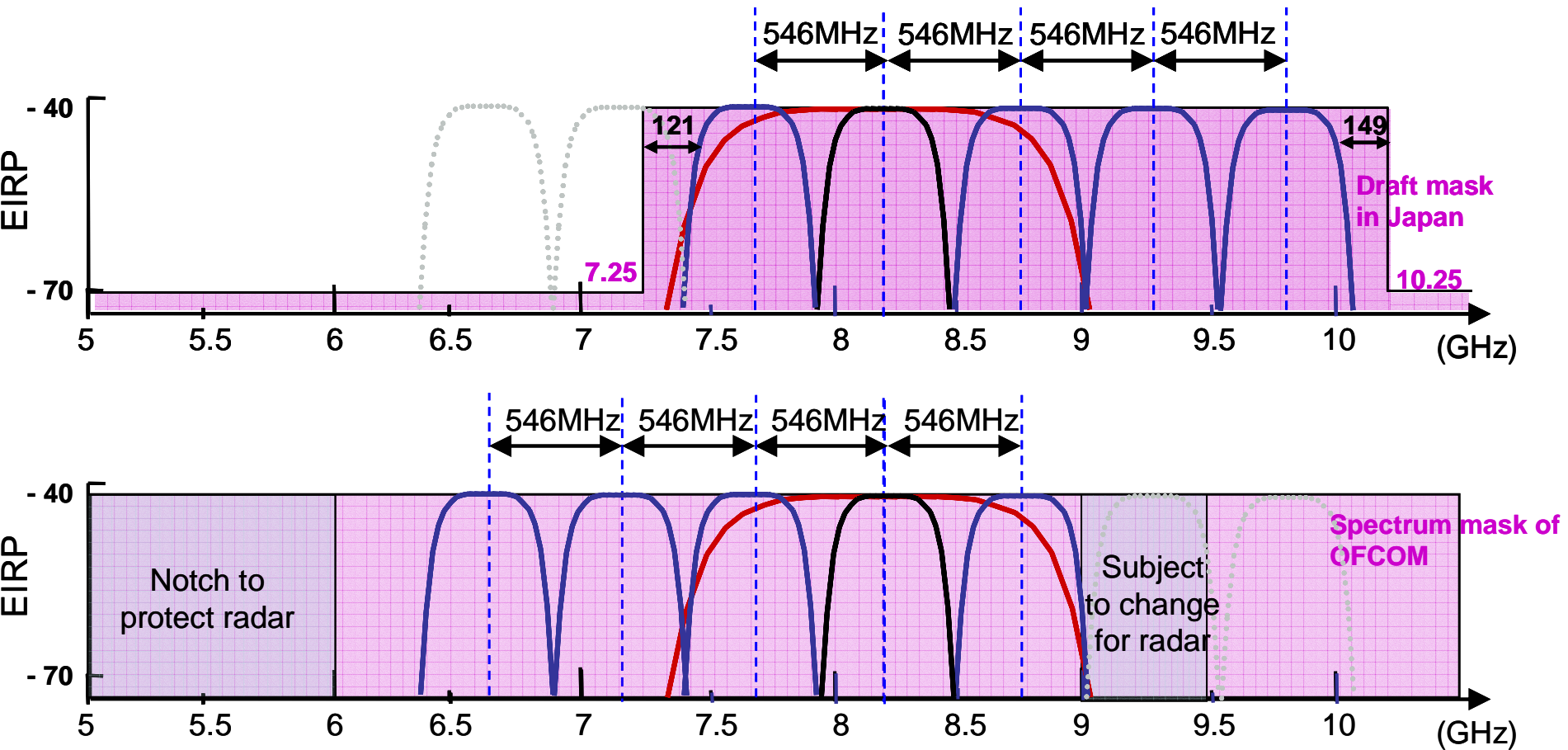
Prime factors: 3, 5, 7, 13, 17

PLL Reference Diagram (I)



| F_x (MHZ) | R | F_{comp} (MHZ) |
|-------------|----------|------------------|
| (13,26) | (64,128) | 0.203125 |
| (9.6,19.2) | (96,192) | 0.1 |
| (12,24) | (24,48) | 0.5 |

View From Japan and OFCOM (I)



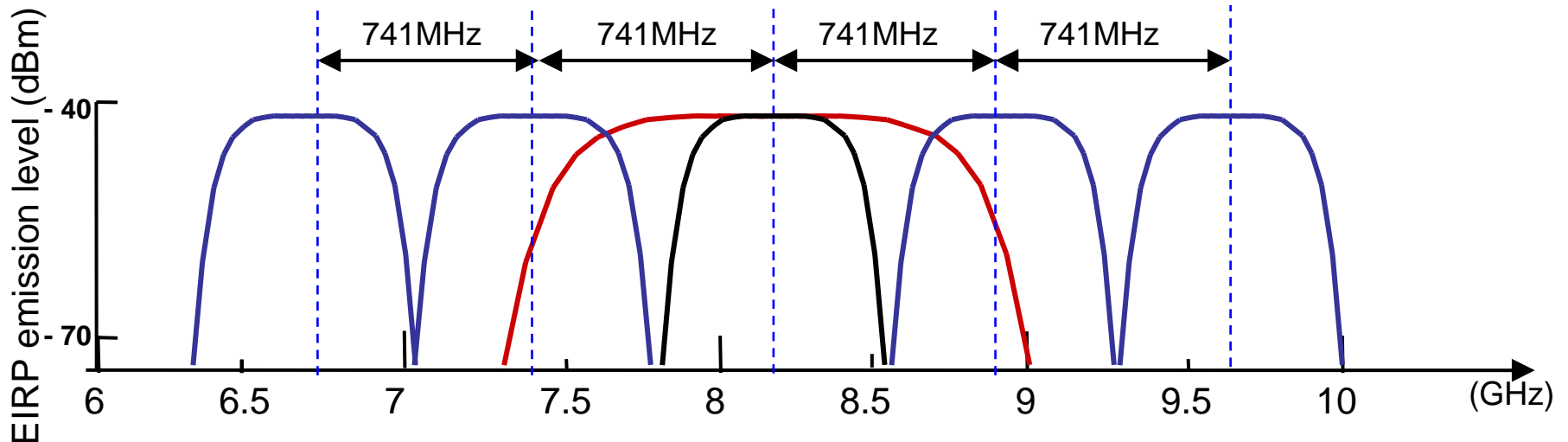
Facts of Band Plan (I)

- Advantages
 - Efficient use of channels (more available sub bands).
 - 500 MHz band width as low band.
- Disadvantages
 - Different PRF from the low band plan.

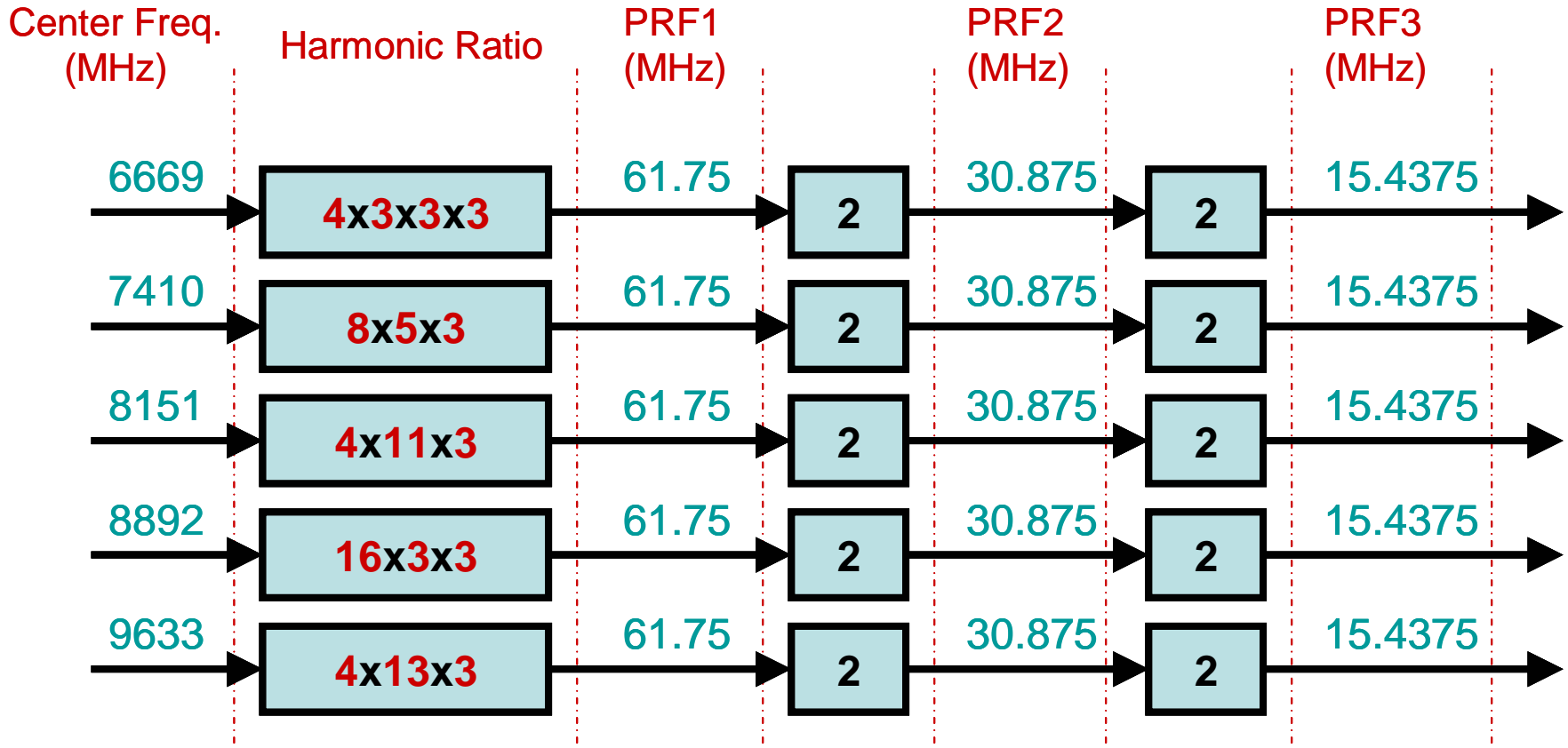
Above 6.1 GHz Proposal 2

Band Plan (II)

| Band No. | Bandwidth (MHz) | Low Freq. (MHz) | Center Freq. (MHz) | High Freq. (MHz) |
|---------------|-----------------|-----------------|--------------------|------------------|
| 1 | >500 | 6298.5 | 6669 | 7039.5 |
| 2 | >500 | 7039.5 | 7410 | 7780.5 |
| 3 (mandatory) | >500 | 7780.5 | 8151 | 8521.5 |
| 4 | >500 | 8521.5 | 8892 | 9262.5 |
| 5 | >500 | 9262.5 | 9633 | 10003.5 |
| 6 | ~1600 | 7351 | 8151 | 8951 |

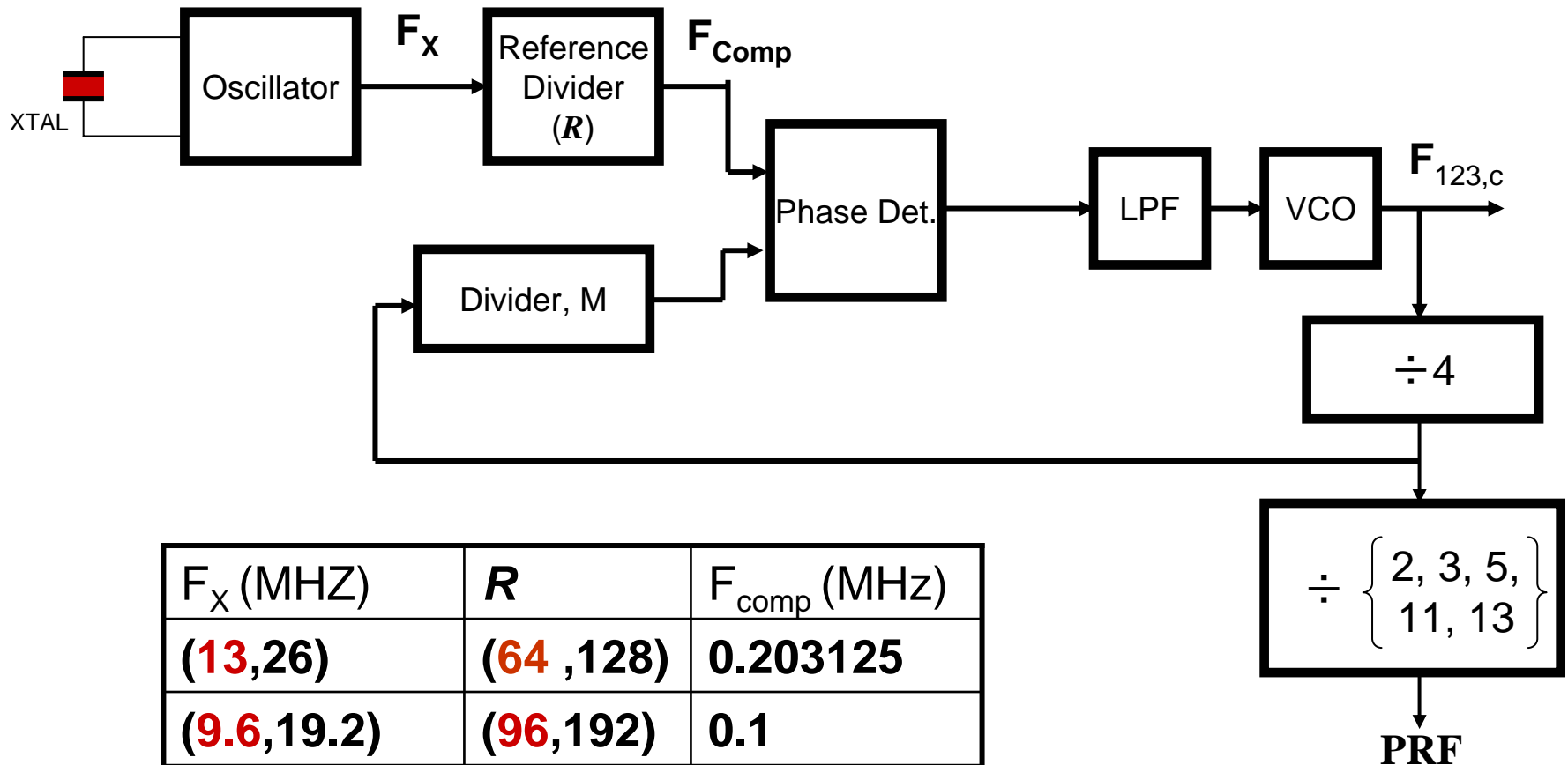


PRF Generation (II)



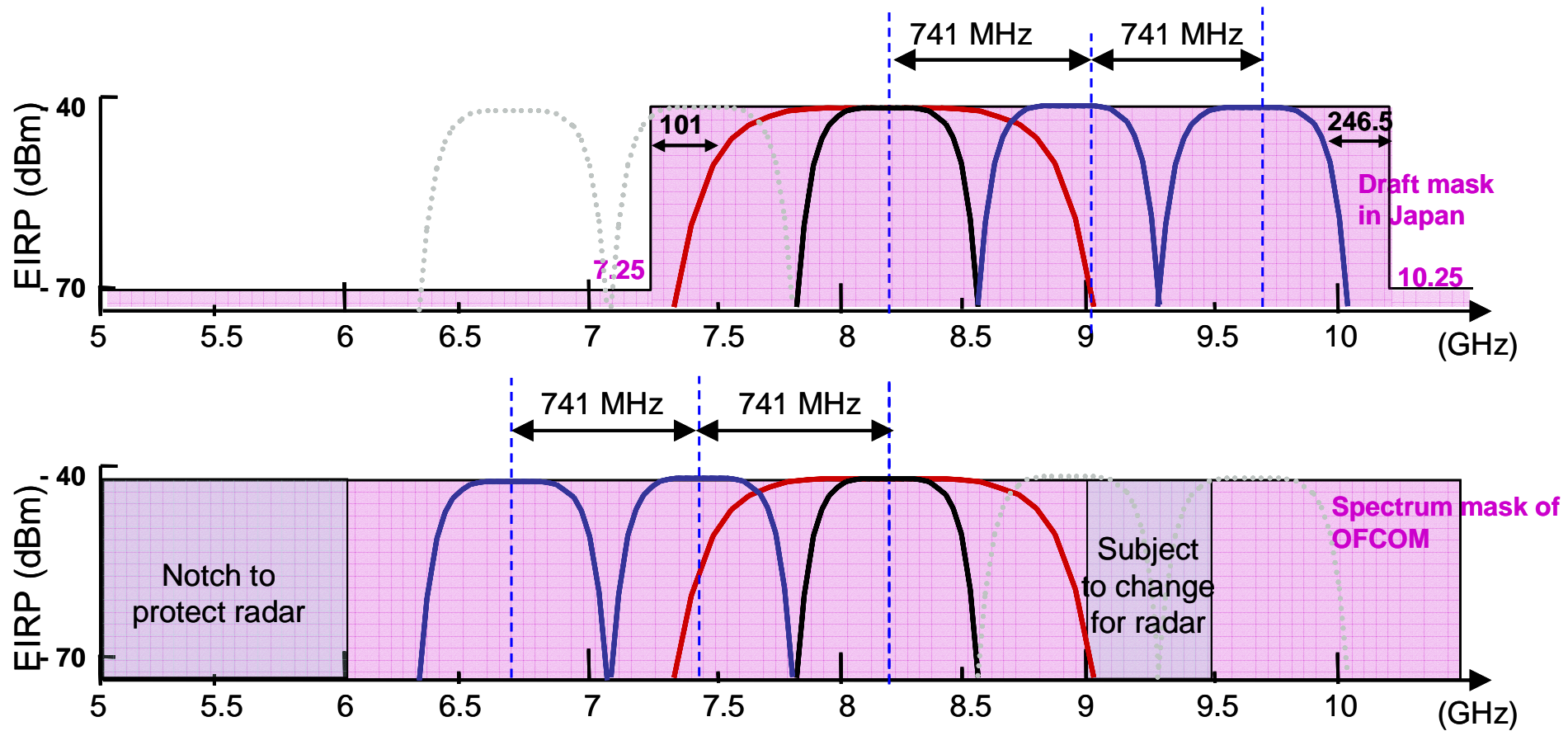
Prime factors: 3, 5, 11, 13

PLL Reference Diagram (I)



| F_x (MHZ) | R | F_{comp} (MHZ) |
|-------------|----------|------------------|
| (13,26) | (64,128) | 0.203125 |
| (9.6,19.2) | (96,192) | 0.1 |
| (12,24) | (24,48) | 0.5 |

View From Japan and OFCOM (II)



Facts On Band Plan (II)

- Advantages
 - Large margins between sub bands.
 - Same PRF as the low-band plan.

- Disadvantages
 - Less efficient use of channel (less number of sub bands).

Conclusion Remarks

- Two band plans for above 6 GHz were Proposed.
 - Taking into account the current spectrum masks of both OFCOM and Japan.
 - Including as more as sub bands.
 - Using small prime factors.
- Tradeoff between plan 1 and plan 2
 - Available number of sub bands.
 - PRF adhere to low band or not.