

# Infineon Wi-Fi Regulatory training

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# Agenda

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- › Introduction
- › Basics of CLM
- › Regulatory strategy
- › CLM Process
- › CLM testing
- › Q&A

# Introduction

## Introduction

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- › Worldwide deployment of Wi-Fi products
- › Each country regulates the allowed Wi-Fi radio transmission frequency channels and power limit per channel
- › Each country has a regulatory body to oversee compliance
- › Each regulatory body would publish specific testing guidelines
- › Infineon Wi-Fi chips are loaded with “CLM BLOB” file containing regulatory compliance data to satisfy the specific regulatory requirements of target countries.

## Regulatory bodies for commonly scoped countries

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- › United States of America – Federal Communications Commission (FCC)
- › Canada – Innovation, Science and Economic Development (ISED)
- › Taiwan – National Communications Commission (NCC)
- › Europe – European Telecommunications Standards Institute (ETSI)
- › India – Telecom Regulatory Authority of India (TRAI)
- › China – State Radio Regulation of China (SRRC)
- › Japan – Ministry of Internal Affairs and Communications (MIC)
- › South Korea – Korea Communication Commission (KCC)

# Basics of CLM

## What is CLM?

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- › Regulatory configuration is encapsulated in Country Locale Matrix (CLM)
- › CLM is a database containing the following regulatory configuration:
  - Country codes
  - Locales
  - Transmission power limit per channel per rate
  - Other regulatory requirements
- › Country code-Two-letter ISO representation of a country (eg. CA for Canada)
- › Locale-Set of channel, rate, power for specific frequency band and bandwidth
- › Each country code contains a set of locales
- › CLM is encapsulated in a binary file, also known as CLM BLOB
- › Wi-Fi driver would download the CLM BLOB file to the WLAN radio during initialization
- › The host processor can set the country code

# Regulatory Strategy



# Regulatory strategy

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- › SKU planning
  - Number of target countries to ship
  - Country groups: Can you combine the country codes with similar regulatory requirements? For instance, countries in EU region collectively represented by 1 single country code
  - Are there restrictions in channel mapping while combining the country codes?
    - ch. 12, 13 restrictions in US
    - Indoor/outdoor channels
    - DFS
    - Adaptivity
  - Requirement of World Wide Safe
  
- › SKU management
  - Static SKU
  - Dynamic SKU
  - Single SKU
  
- › For more details, kindly refer to **section 6 SKU Planning Guidance** in Wi-Fi regulatory manual

## Example Country Grouping for indoor channels

Group	Pseudo-code	Target countries	2.4GHz allowed channels	5GHz allowed channels	Restricted channels
1	US	US, CA, MX, AR	1-11	36-64, 100-116, 132-144, 149-165	120-128
2	DE	All EU countries	1-13	36-64, 100-140, 149-165	N/A
3	XX	Rest of world/world wide safe	1-11	None	All 5GHz channels

# CLM Process



## CLM Process

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- › Customer works with the EMC lab to finalize the regulatory compliant channel map/ transmission power limit\* required for each country.
- › If the customer is using a WLAN module, they contact their module vendor and raise a request for a BLOB to them.
- › If a WLAN chip is being used, customer fills out the regulatory [template](#) and submits it to IFX through an FAE/MyCases portal and we deliver the BLOB in a week's time\*\*.

\* WL tool, txpwr1 and mfgtest firmware required

\*\*Provided we don't need any clarifications and the provided sheets are exactly what is given in the template

## Guidelines to fill up the Regulatory Templates

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- › Project information tab should be filled to reflect the requirement
- › Power numbers for the channels needed, needs to be filled for the corresponding 802.11 schemes
- › For channels/Modulation schemes which are not in the purview of the product, add a 'NS' or leave the corresponding cell empty.
- › Do not add/remove any tabs/columns or change any column names from the regulatory template as this drastically increases the time needed to build the BLOB.
- › If a requirement arises where multiple power numbers are required say a power of 13dBm for 6-18Mbps and 12dBm for 24-54Mbps of 802.11a, the modulation scheme needs to be added as OFDM6-18 and OFDM24-54 in separate rows.
- › If there are any confusions regarding this, contact IFX and we will evaluate the request on a case by case basis\*.

\* This is to reduce the time that will be needed by Customer and IFX in generating the BLOB.

# CLM Testing

# CLM Testing

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The following WL commands can be used to check whether the requested data has been built into the BLOB accurately by IFX before going into regulatory certification

- › `wl clmver` – Display string formatted information on CLM version
- › `wl country list` – Display the list of supported countries in CLM blob
- › `wl country <ccode>` – Set the two-letter ISO country code <ccode>. Without <ccode>, the command returns the current country code
- › `wl chan_info` – Obtain channel information
- › `wl channel <chan>` – Set a channel. Without <chan>, the command returns the current channel
- › `wl curpower` – Display the regulatory, board and target power limits for a particular channel for all supported rates. This command works only with mfgtest firmware

## Curpower details

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- › Regulatory Limit -> set by the BLOB
- › Board limit -> set by the NVRAM
  - In practice, board limits are never configured because measured power numbers are collected in CLM
- › Power target ->  $\min(\text{Regulatory Limit, Board Limit}) - 1.5\text{dB}$
- › 1.5 dB is to account for power detector uncertainty.



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## Abbreviations

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- › CLM – Country Locale Matrix
- › SKU – Stock Keeping Unit
- › DFS – Dynamic Frequency Selection
- › BLOB – Binary Large Object

# References

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- › <https://www.cypress.com/documentation/application-notes/an225347-cypress-wi-fi-clm-regulatory-manual>