RoboCup2017 Wireless LAN Guideline・Rules・Operation (Draft)

The RoboCup 2017 Nagoya Local Organizing Committee

Ver.0.7.2

2017/ July /11

<Guide>
Policy and Concept Regarding the Use of Wireless Devices at RoboCup

1. The RoboCup Local Organizing Committee (LOC) will coordinate the use of radio resources by visitors and competitors so that the competition can be conducted smoothly.

2. The Committee will assign radio frequencies (LAN channels, etc.) to all leagues participating in the competition.

3. Each league should use the assigned frequencies (LAN channels, etc.) to ensure trouble-free operation during the competition.
   - Each league can use the specified frequencies preferentially.
   - Where particular circumstances of a league (competitor) require the use of frequencies other than those assigned, the league's representative should coordinate with the representatives of other leagues.

4. Each league/competitor is not allowed to use radio frequencies in a way that affects the progress of the competition.
   - All activities at the competition must comply with local laws and regulations on wireless use.

5. Any operational failures of the robots that are thought to be caused by radio interference should be resolved by the competitors experiencing the failure.
   - If radio interference is caused by other leagues, the chairs of the relevant leagues and the Committee will assist in resolving the problem, if necessary.

<Common Rules> for 2.4 GHz and 5 GHz Wireless LANs

- **Generally, is prohibited to use any radio frequencies other than those assigned to each league.**
  - See the attached table.

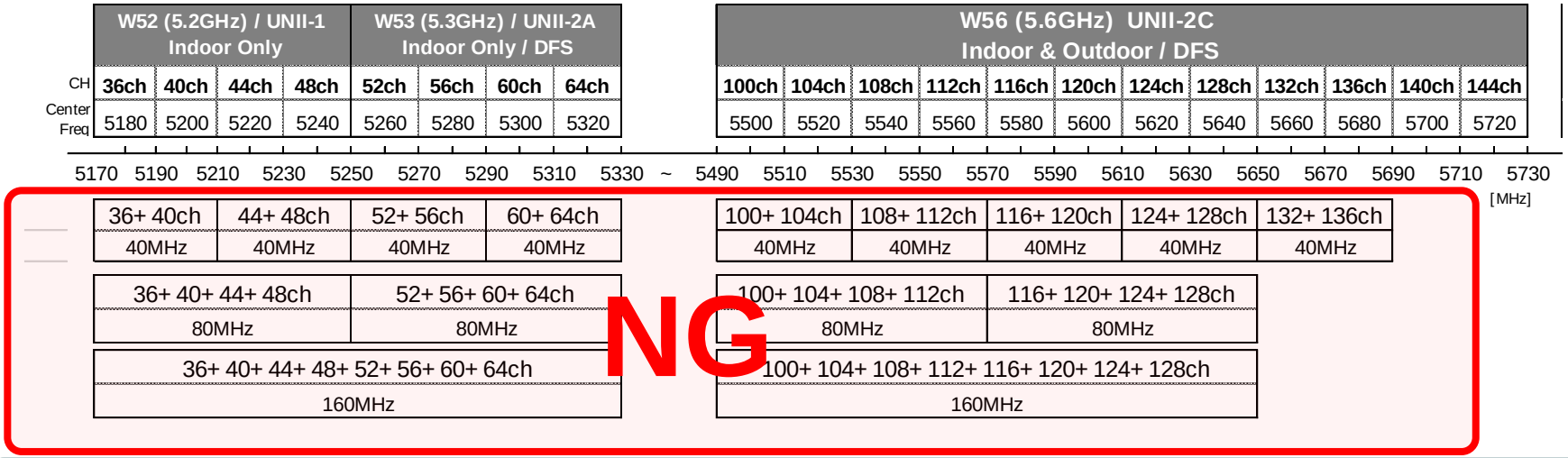
- **It is prohibited to use "Channel Bonding"(Dual Channel / Wide Channel / Ethernet Bonding) that uses several channels (40, 80, and 160 MHz-frequency bands) simultaneously.**
  - IEEE 802.11a/b/g/n/ac uses 20 MHz per channel.

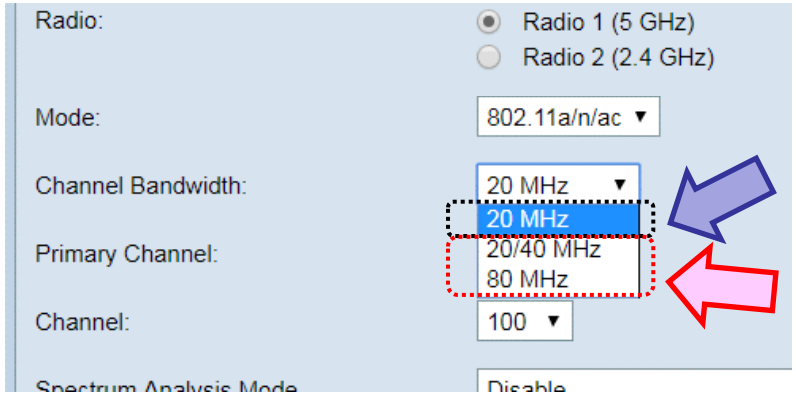
- **It is prohibited to use any Wireless LAN access point (AP) other than one installed by the Committee.**
  - For Rescue Robot Leagues, each team can use an AP.

- **When an AP is installed and set, the following information should be indicated on the AP.**
  - SSID
    Wireless Standard (e.g. 2.4 GHz/5 GHz, IEEE802.11ac/a/b/g/n)
    Channel used (1ch, 5ch, etc.)

<Reference> Channel Bonding

- **Rules for 2.4 GHz and 5 GHz Wireless LANs at RoboCup:**
  "Channel Bonding" is a logical procedure for utilizing multiple connections (channels) for increased throughput.
  - Dual Channel / Wide Channel / Ethernet Bonding,





OK (20MHz)

NG (20/40MHz, 40MHz, 80MHz, 160MHz)

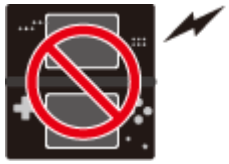
<Common Rules> for Each League

- **It is prohibited to use wireless functions of PCs and peripheral devices that are not used in the competition.**
  - It is prohibited to use wireless mice and keyboards (and other wireless peripheral devices using any frequency).

- **Generally, it is prohibited to use “Mobile Wi-Fi routers”.**
  - It is prohibited to use the tethering function of a smartphone or mobile router.
  - Using a wired connection (e.g. USB connection), however, is allowed.

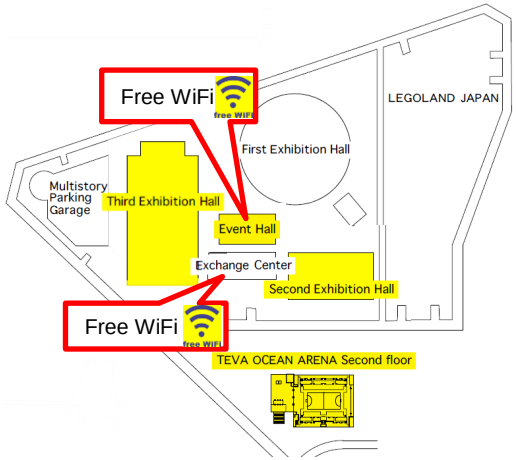
- **The Wireless LAN and Bluetooth functions of all portable devices must be turned off.**
  - The Wireless LAN and Bluetooth functions of smartphones, iPhones, tablet PCs, iPad and other devices that are not used in the competition should be turned off.
  - It is prohibited to use Bluetooth headsets with mobile phones, as well as other wireless headphones with music players.

- **It is prohibited to use any type of portable game machine in the venue.**
  - Portable game machines include Nintendo DS series and SONY PSP.
    - It is prohibited to use any portable devices whose wireless on/off status cannot be confirmed externally.
      (* Mobile phones and personal handy phones (PHSs) are allowed.

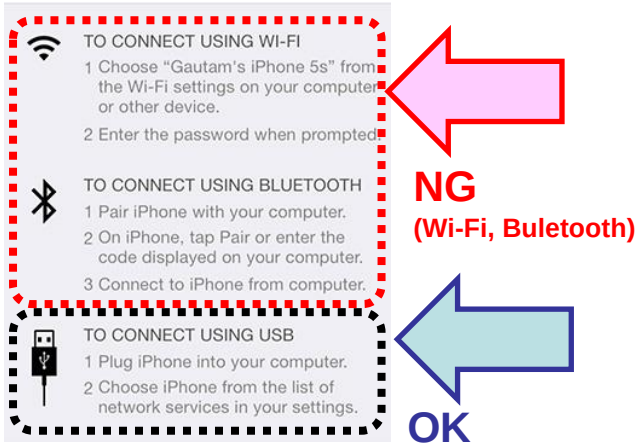


<Reference> Internet Environment Provision

- FreeWi-Fi will be installed in “Event Hall” and ”Exchange Center”



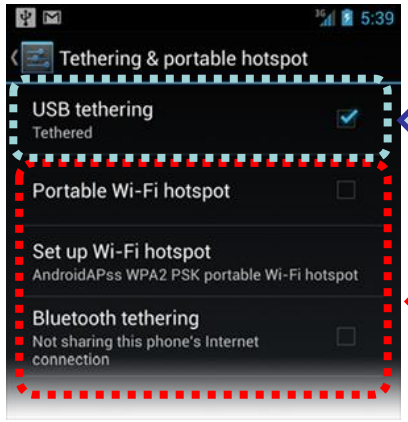
- Tethering of Smartphones and Mobile routers can only "USB Connection"



NG
(Wi-Fi, Buletooth)

OK
(USB Tethering)

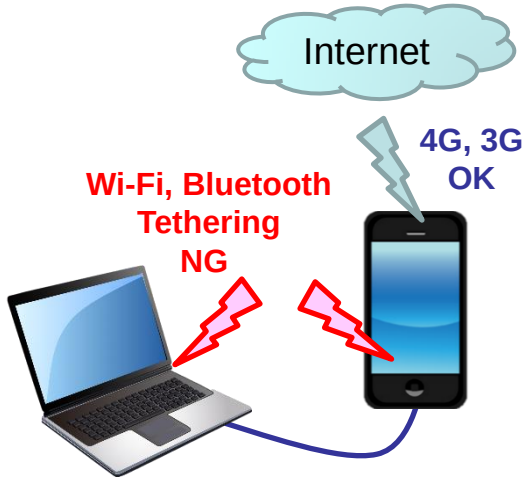
iPhone USB Tethering



OK
(USB Tethering)

NG
(Wi-Fi, Bluetooth)

Android USB Tethering



<Rules> 2.4 GHz Devices

- **For the 2.4 GHz band, only the following standards are allowed.**
  - Major: Wireless LAN (IEEE 802.11b/g/n/ac)
    - * It is recommended to unify the standard (to 11b/g/n/ac) within each league.
      Using several standards simultaneously decreases the communication speed.
    - Wireless devices must be able to set the frequency to be used and select from among the 14 channels for wireless LANs.
    - Only Small Size Soccer Leagues can use ZigBee (IEEE 802.15.4).
  - Junior: Bluetooth (IEEE 802.15.1)
    - For radio output, only Class 2 (2.5 mW) and Class 3 (1 mW) are allowed.
      - Class 1 (100 mW) devices cannot be used.

- **For Wireless LAN channels, channels [1ch, 5ch, 9ch and 13ch/14ch] can be used.**
  - In principle, it is better to use channels 1, 6 and 11. However, since the number of leagues has increased, all of the above four channels will be used.
    Since areas of approximately 1 MHz of each channel overlap the neighboring channels, communication speed is slightly reduced.

- **It is prohibited to use Wireless LAN devices that cannot set the frequencies.**
  - APs that dynamically change frequencies (by frequency hopping) are not allowed.

- **Generally, it is prohibited to use wireless devices with proprietary standards, such as:**
  - Wireless game controllers
  - Video transmitters (video transfer equipment)
  - Radio-control transmitters using the 2.4 GHz band

<Rules> Bluetooth (IEEE 802.15.1) / ZigBee (IEEE 802.15.4)(2.4 GHz)

- **Junior Leagues can use Bluetooth devices under the following conditions:**
  - Standard: Version 1.2 or later
  - Output: Class 2 (2.5 mW) or Class 3 (1 mW)
    - Class 1 (100 mW) devices are not allowed.
  - If it is confirmed that a Bluetooth device affects the devices used by Senior Leagues, its use should be immediately stopped.
  - Senior Leagues are not allowed to use Bluetooth devices.

Class	Output	Use
Class 1	100 mW	**NG**
Class 2	2.5 mW	OK
Class 3	1 mW	OK

Version (Standard)	Use
1.0b	**NG**
1.0b+CE	**NG**
1.2	OK
2.0 (2.0+EDR) or later	OK

- **Only Small Size Soccer Leagues, Junior Leagues can use ZigBee (IEEE 802.15.4).**

Proposed

ch	11ch	12ch	13ch	14ch	15ch	16ch	17ch	18ch	19ch	20ch	21ch	22ch	23ch	24ch	25ch	26ch
MHz	2405	2410	2415	2420	2425	2430	2435	2440	2445	2450	2455	2460	2465	2470	2475	2480
	Junior				Junior				Junior				Small Size Soccer League			

<Rules> Radio Control

- **Generally, it is prohibited to use a radio-control transmitter in competition.**

- **26 MHz, 40 MHz, and 72 MHz for radio control**
  - When using the above frequencies, approval should be acquired from the Committee in advance (concerning permitted frequencies and bands).
  - Measures for changing frequencies should be provided.
    - Preparing several crystal oscillators, etc.

- **Radio-control transmitters using the 2.4 GHz band are not allowed.**
  - It is prohibited to use radio-control transmitters using the 2.4 GHz band from any manufacturer.

  * Since the frequency characteristics of these devices are not standardized, whether each device causes interference has currently not been confirmed.

<Other Rules> for Exhibitions by Companies

- **Generally, it is prohibited for company exhibitors to use wireless.**
  - Only the 5 GHz band can be used in Second Exhibition Hall.

- **Food exhibitors**
  - Food exhibitors cannot use microwave ovens, wireless POS devices (e.g. cash registers, bar code readers).

NG

- **Wireless microphone is prohibited in principle**
  - Wireless microphones that do not use 2.4 GHz are conditional and acceptable.

Wired Microphone

OK

Wireless Microphone

NG

<Operation> Radio frequencies management

- **Radio frequency managed by RoboCup2017 is "2.4 GHz / 5 GHz band" only**
  - Do not manage except the 2.4 GHz / 5 GHz band in principle

- **In case of radio trouble, adjust between leagues through radio manager of each league**
  - LOC appoints a Radio Surveillance at the 3rd Exhibition Hall
  - Radio Surveillance monitors 2.4 GHz / 5 GHz band
  - When the Radio Surveillance can confirm the problem, it reports to the LOC of the corresponding league and supports the adjustment

- **It is prohibited to connect Wi-Fi to Internet line (Wired LAN)**
  - However, except the following
  - Wi-Fi prepared by the LOC
  - @Home league (3rd Exhibition Hall) Wi-Fi to use in competition

<Operation> Assignment of Preferred Wireless LAN Channels

Adjusting

RoboCup 2017

Hall	League	2.4 GHz	5 GHz	SSIDs (Example)
Third Exhibition Hall	Humanoid Soccer League	1ch (Competition)	60ch / 64ch (Practice)	HL_FIELD_A_1ch HL_FIELD_B_1ch :
	Standard Platform League (NAO)	5ch (Competition)	60ch / 64ch (Practice)	spl_5 ch spl_60ch
	Meddle Size Soccer League	9ch (Competition)	36ch (Competition) 52ch / 56ch (Practice)	mssl_36ch mssl_52ch
	Small Size Soccer League	13ch / 14ch / ZigBee (Competition)	48ch (Competition)	sssl_13ch sssl_48ch
	Industrial (@Work)	9ch (Competition)	100ch / 104ch (Practice)	work_48ch_*** work_100ch_***
	Industrial (Logistics)	9ch (Competition)	100ch / 104ch (Practice)	Logi_9ch_*** Logi_100ch_***
	@Home Open Platform League (OPL)	----	36ch (Competition) 52ch / 56ch (Practice)	home_36ch home_60ch
	@Home Social Standard Platform League (SSPL) (Pepper)	----	40ch (Competition) 108ch / 112ch (Practice)	SSPL_40ch SSPL_108ch
	@Home Domestic Standard Platform League (DSPL) (HSR)	----	44ch (Competition) 116ch/120ch/124ch (Practice)	DSPL_44ch DSPL_120ch
	Amazon Robotics Challenge (ARC)	----	128ch / 132ch	arc_124ch_***
	Company Exhibition Booth	----	----	----
Takeda TEVA OCEAN ARENA	Rescue Robot League	----	36 / 40 / 44 / 48ch 52 / 56 / 60 / 64ch	rrl_48ch_***
	Junior Rescue	Bluetooth/ZigBee	----	-
Event Hall	Simulation League (Soccer / Rescue)	FreeWiFi	----	-
Second Exhibition Hall	Junior Soccer, Junior On-stage	Bluetooth/ZigBee	----	-
	Company Exhibition Booth	----	36 / 40 / 44 / 48c	-

<Operation> Assignment of Preferred Wireless LAN Channels

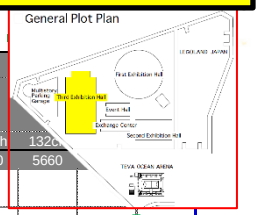
Adjusting

Third Exhibition Hall

Competition Band **Practice Band**

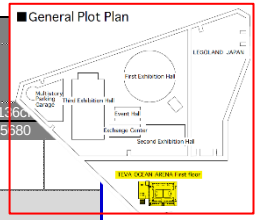
League / Category		abbr.	Buletooth 2.4GHz	2.4[GHz] 1ch	5ch	9ch	13ch	5.2[GHz] (W52 / UNII1) 36ch	40ch	44ch	48ch	5.3[GHz] (DFS&TPC) (W53 / UNII2A) 52ch	56ch	60ch	64ch	5.6[GHz] (DFS&TPC) (W56 / UNII2C) 100ch	104ch	108ch	112ch	116ch	120ch	124ch	128ch	132ch
	Center Freq		Center Freq	2412	2432	2452	2472	5180	5200	5220	5240	5260	5280	5300	5320	5500	5520	5540	5560	5580	5600	5620	5640	5660
Soccer	Humanoid League	SHL	-	1										52	56									
	Standard Platform League	SPL	-		5									60	64									
	Middle Size League	MSL	-			9		36				52	56											
	Small Size League	SSL	ZigBee				13ch 14ch				48													
Industrial	Logistics League	LL	-			9ch										100	104							
	@Work	Work	-			9ch										100	104							
@Home	@Home Open Platform League	OPL	-					36				52	56											
	@Home Social Standard Platform League (Pepper)	SSPL	-						40									108	112					
	@Home Domestic Standard Platform League (HSR)	DSPL	-							44										116	120	124		
Amazon Robotics Challenge		ARC																					128	132
Robot Exhibition		REx		Do not use																				

52 - 64ch(W53), 100 - 140ch(W56)
DFS (Dynamic Frequency Selection)
TPC (Transmit Power Control)



Teva Ocean Arena

League / Category		abbr.	2.4[GHz] 1ch	5ch	9ch	13ch	5.2[GHz] (W52/UNII1) 36ch	40ch	44ch	48ch	5.3[GHz] (DFS&TPC) (W53/UNII2) 52ch	56ch	60ch	64ch	5.6[GHz] (DFS&TPC) (UNII3) 100ch	104ch	108ch	112ch	116ch	120ch	124ch	128ch	132ch	136ch
										5240	5260	5280	5300	5320	5500	5520	5540	5560	5580	5600	5620	5640	5660	5680
Rescue	Rescue Robot League	RRL	Do not use				36	40	44	48	52	56	60	64										
	Junior Rescue	JR	Buletooth / ZigBee				Do not use																	
	Junior Rescue-CoSpace	JRC	Buletooth / ZigBee				Do not use																	



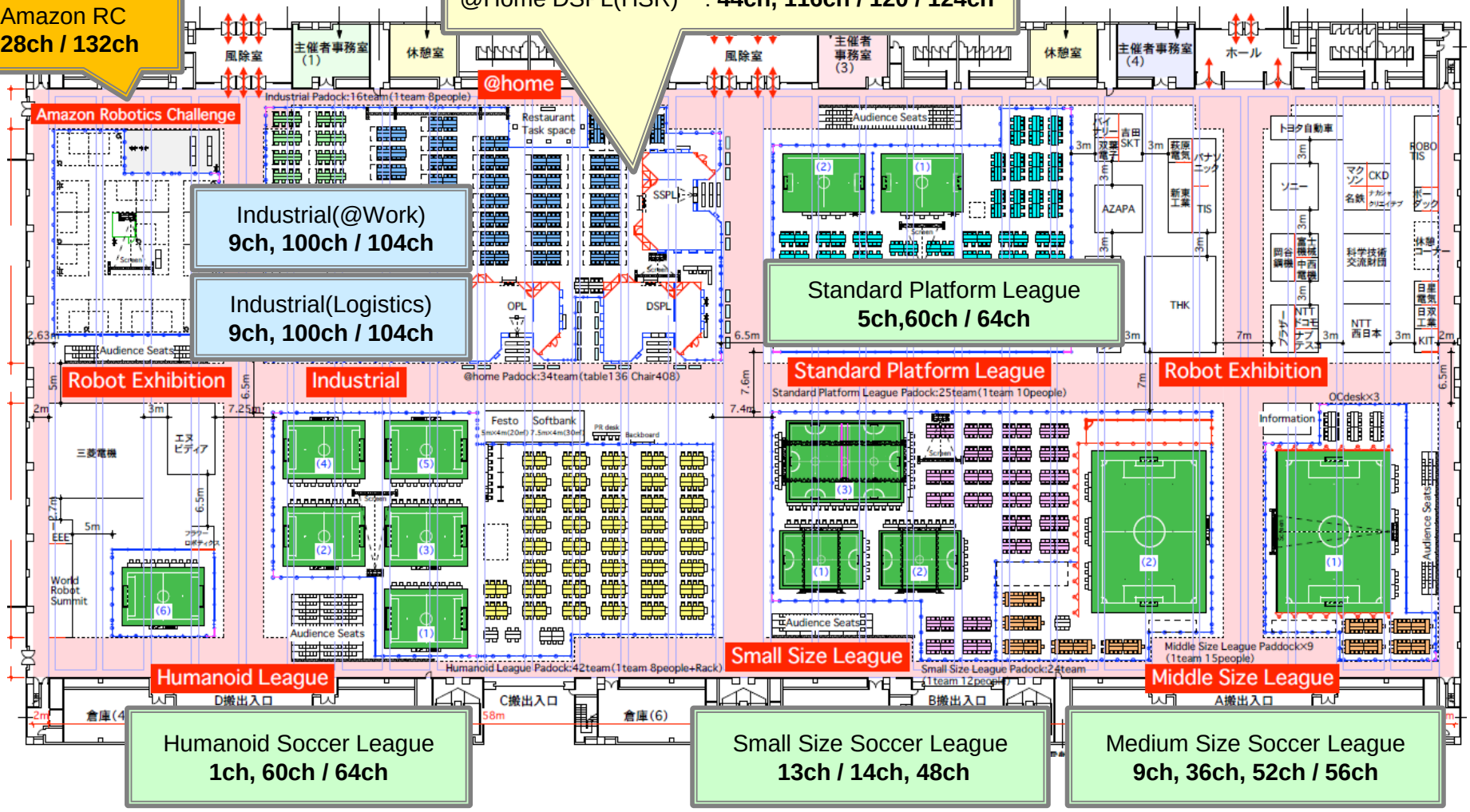
<Reference> Floor Plan : Third Exhibition Hall (May/01 Ver.)

RoboCup 2017
Nagoya Japan

Adjusting

@Home OPL : **36ch, 52ch / 56ch**
@Home SSPL(Pepper): **40ch, 108ch / 112ch**
@Home DSPL(HSR) : **44ch, 116ch / 120 / 124ch**

Amazon RC
128ch / 132ch



Industrial(@Work)
9ch, 100ch / 104ch

Industrial(Logistics)
9ch, 100ch / 104ch

Standard Platform League
5ch,60ch / 64ch

Humanoid Soccer League
1ch, 60ch / 64ch

Small Size Soccer League
13ch / 14ch, 48ch

Medium Size Soccer League
9ch, 36ch, 52ch / 56ch

<Reference> Floor Plan (May/01 Ver.)

Third Exhibition Hall

- Humanoid Soccer League
  Standard Platform League
  Medium Size Soccer League
  Small Size Soccer League
- Industrial (@Work)
  Industrial (Logistics)
- @Home Open Platform League
  @Home Social Standard Platform League
  @Home Domestic Standard Platform League
- Amazon Robotics Challenge
- Company Exhibition Booth

Second Exhibition Hall

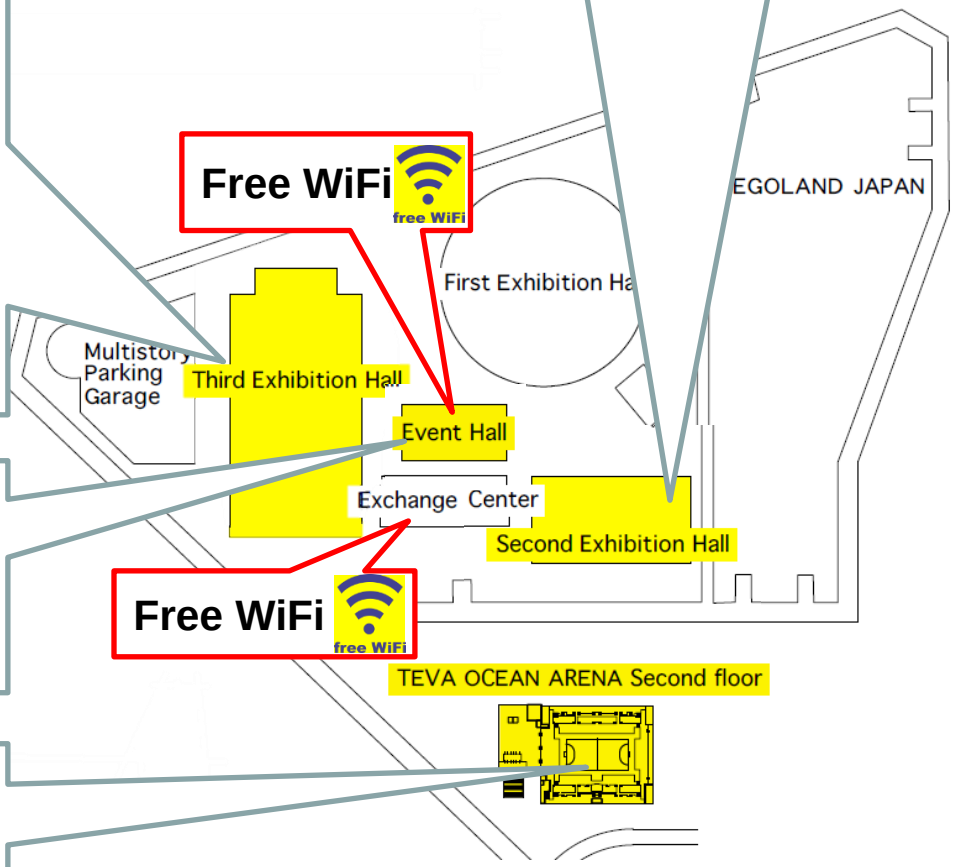
- Junior Soccer / Junior On Stage
- Robot Exhibition

Event Hall

- Soccer Simulation 2D/3D
- Rescue Simulation

Takeda TEVA OCEAN ARENA

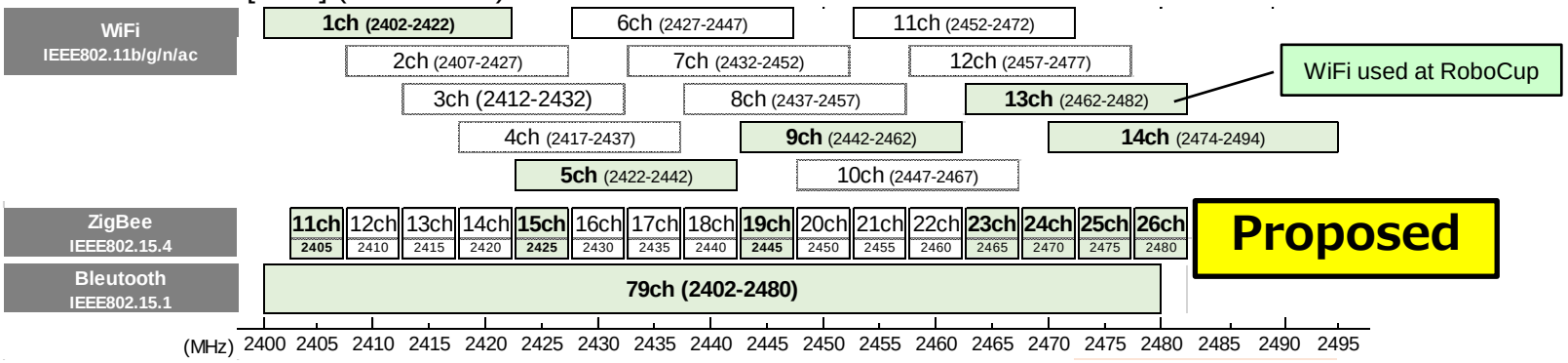
- Rescue
- Junior Rescue



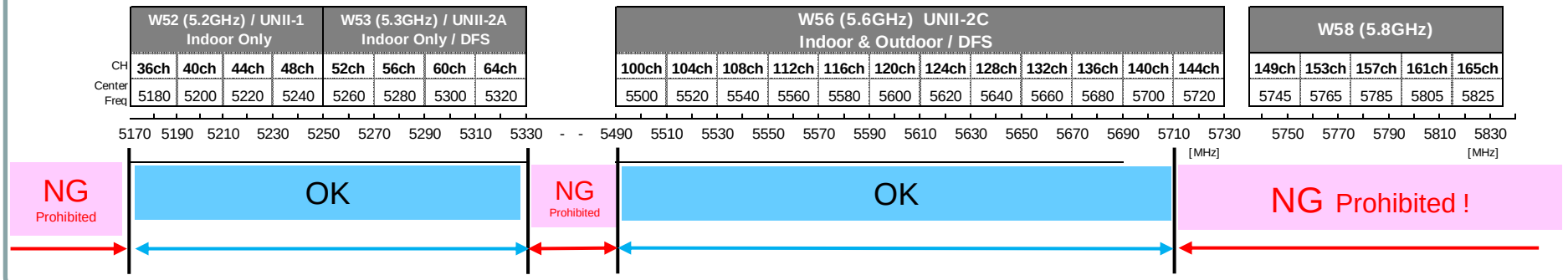
<Reference> Wireless LAN Frequencies Allowed for Use in Japan

Ministry of Internal Affairs and Communications
http://www.tele.soumu.go.jp/e/index.htm

- **2.4 GHz band** (IEEE802.11b/g/n/ac, IEEE802.15.1, IEEE802.15.2)
  - 2483.5～2497[MHz] (1ch～14ch)



- **5 GHz band** (IEEE802.11a/n/ac)
  - 5170～5250[MHz] (W52，U - NII-1：36ch～48ch)
  - 5250～5330[MHz] (W53，U - NII-2A：52ch～64ch)
  - 5490～5710[MHz] (W56，U - NII-2C：100ch～140ch)



<Reference> Usage status of 5GHz in each country

	W52 (5.2GHz) / UNII-1				W53 (5.3GHz) / UNII-2A			
CH	36	40	44	48	52	56	60	64
Center Freq (MHz)	5180	5200	5220	5240	5260	5280	5300	5320
Japan	IN	IN	IN	IN	IN DFS TPC	IN DFS TPC	IN DFS TPC	IN DFS TPC
US	O	O	O	O	DFS	DFS	DFS	DFS
Canada	O	O	O	O	DFS	DFS	DFS	DFS
EU	O	O	O	O	IN DFS TPC	IN DFS TPC	IN DFS TPC	IN DFS TPC
China	NG	O	O	O	DFS TPC	DFS TPC	DFS TPC	DFS TPC
Korea	O	O	O	O	O	O	O	O
Taiwan	NG	NG	NG	NG	NG	O	O	O
Shigapore	O	O	O	O	IN DFS TPC	IN DFS TPC	IN DFS TPC	IN DFS TPC

	W56 (5.6GHz) UNII-2C											
CH	100	104	108	112	116	120	124	128	132	136	140	144
Center Freq (MHz)	5500	5520	5540	5560	5580	5600	5620	5640	5660	5680	5700	5700
Japan	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	NG
US	DFS	DFS	DFS	DFS	DFS	DFS	DFS	DFS	DFS	DFS	DFS	DFS
Canada	DFS	DFS	DFS	DFS	DFS	NG	NG	NG	DFS	DFS	DFS	DFS
EU	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	DFS TPC	NG
China	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
Korea	O	O	O	O	O	O	O	O	NG	NG	NG	NG
Taiwan	O	O	O	O	O	O	O	O	O	O	O	NG
Shigapore	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG

	W58 (5.8GHz)				
CH	149	153	157	161	165
Center Freq (MHz)	5745	5765	5785	5805	5825
Japan	NG	NG	NG	NG	NG
US	O	O	O	O	O
Canada	O	O	O	O	O
EU	△	△	△	△	△
China	O	O	O	O	O
Korea	O	O	O	O	O
Taiwan	O	O	O	O	O
Shigapore	O	O	O	O	O

* O : Enabled, NG :Prohibited / Disabled, △ : Varies among regions.
* In : Indoor Only
* DFS : Dynamic Frequency Selection, DFS is a spectrum-sharing mechanism that allows wireless LANs to coexist with radar systems.
* TPC : Transmit Power Control

Reference: 無線LAN構築 最強の指南書 (日経ITエンジニアスクール), 日経NETWORK, 2016