Estimation of TV White Space (WS) Availability in Japan

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Abstract

We analyze TVWS availability in Japan by estimating the amount and distribution of TVWSs across Japan. This is the first quantitative analysis on TVWS availability in Japan. Our estimation results show that many metropolitan areas in Japan have many TVWSs. Especially, central Tokyo has more than 20 TVWS channels (120MHz). According to the amount and distribution, TVWSs have the potential to accommodate many new communication devices.

TVWS Methodology and Calculation

Secondary access to the unused portions in TV bands, so-called TVWSs, as a promising and practical application of cognitive radio has attracted not only many researchers but also telecom regulators throughout the world. Fig.1 shows the basic concept of TVWS device regulations. TVWS devices must be located outside the protected area by a required separation distance based on their transmission power and antenna heights.

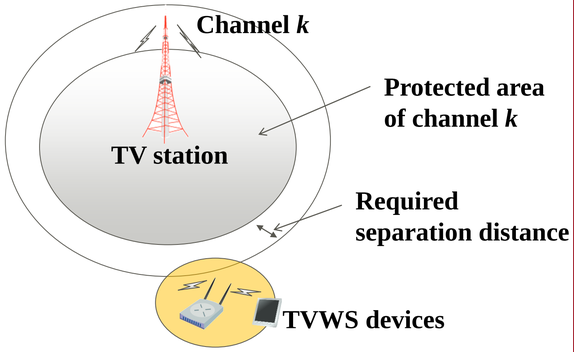


Fig. 1 Basic concept of TVWS device regulations

Calculation Assumption

Items	Values	Remarks
Number of physical TV channels	40	470MHz-710MHz
Propagation model	ITU-R P.1546	Including terrain clearance angle correction.
Propagation curve	F(50,90)	F(X,Y): a two dimensional CCDF, X: spatial percentage, Y: temporal percentage.
Protected contour	41dBuV/m	Same with FCC regulations.
Separation distance (co-channel / adj-channel)	6.0km / 0.1km	Same with FCC regulations for TVWS devices of less than 3 meters antenna height.
Geographical information	SRTM2	NASA product.
Latitude and longitude resolution	0.01 ˚	

Samples of TV Channel Allocation

	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35-52
Tokyo				tv					tv	tv	tv	tv	tv	tv	tv	tv							
Osaka	tv	tv	tv	tv	tv	tv						tv											
Fukuoka										tv				tv		tv		tv	tv	tv		tv	
Hiroshima		tv	tv			tv	tv			tv	tv												
Miyazaki	tv	tv	tv	tv																			

Estimation Results

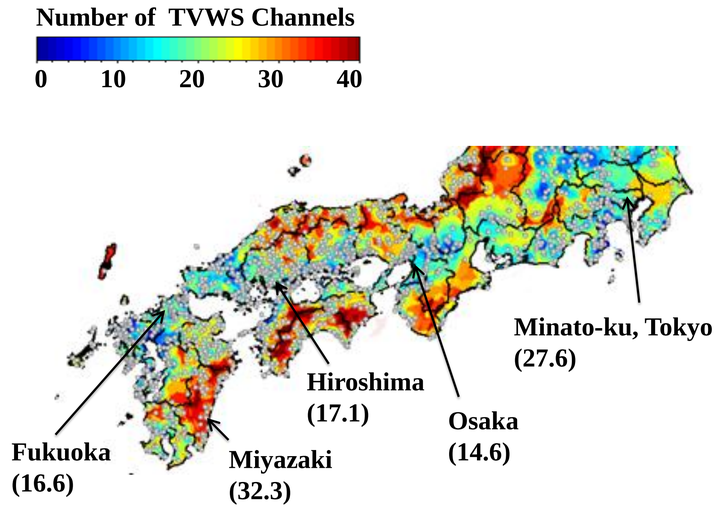


Fig. 2 TVWS map when adjacent channels use is not restricted

Many areas have more than or close to 16.7 channels (100MHz) available for low power TVWS devices.

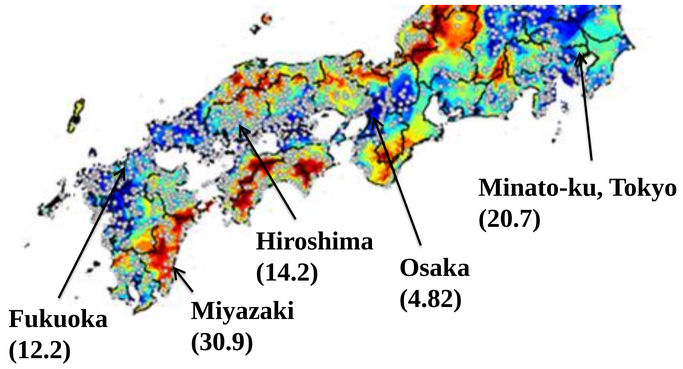


Fig. 3 TVWS map when adjacent channels use is restricted

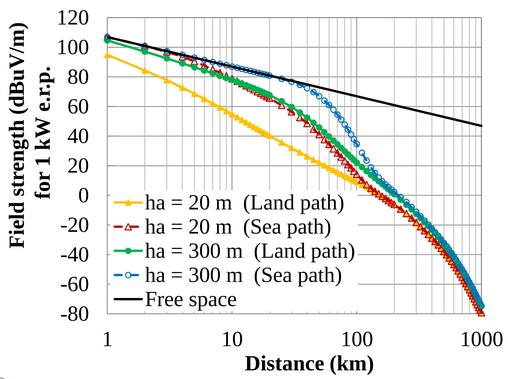
By considering the interference to adjacent channels from large power devices, some areas see a large decrease in available TVWS channels, others do not.

Conclusions

We present an estimation of TVWS availability in Japan. The results are visualized in TVWS maps. There are more than 20 TVWS channels available in central Tokyo, the most populated area in Japan. Overall, many areas in Japan have more than or close to 100 MHz TVWSs. These results encourage further development of applications using TVWSs.

ITU-R P.1546 model

■ Includes propagation curves for land –paths and sea-paths



■ Propagation curves for land –paths are almost identical to FCC curves