



# INTRODUCTION TO MILLIMETRE WAVE TRANSMISSION INDUSTRY SPECIFICATION GROUP mWT ISG

Presented by Debora Gentina

**mmW** 2015

Workshop on millimetre-wave Technology  
for High-speed Broadband Wireless Networks

- **Millimetre Wave (mmW) Background**
  - **Spectrum & Industry**
- **mWT ISG Creation and Main Milestones**
- **Motivation of mWT ISG**
- **Overview of Work Program**
  - **Main Work Items**



- **Millimetre Wave (mmW) Background**

- **Spectrum & Industry**

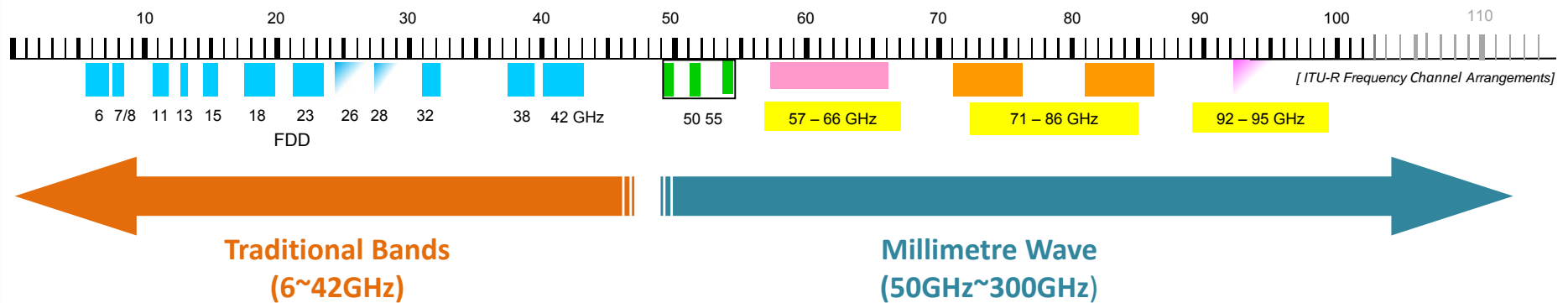
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# mm-wave Spectrum: the New Frontier of Backhauling



- ISG mWT adopts the definition of **Millimetre Wave** as the spectrum above 50 GHz

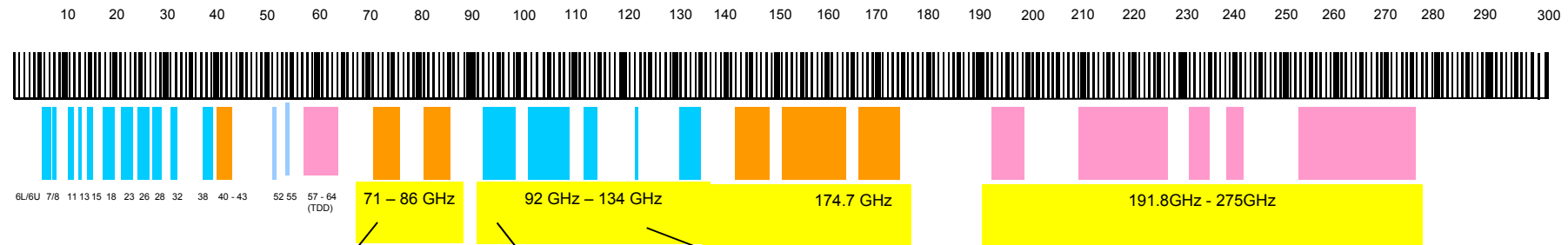


- **Millimetre Wave** as the best choice for **LTE now** and future **5G front/backhauling**:
  - **One order of magnitude of more spectrum available** compared to traditional case
  - Larger bandwidth available, providing **fiber-like capacity** (2G, 4G, 10G, 100G)
  - **Fast Delivery** due to sub-band free and high frequency reuse
  - **Lower TCO**, lower spectrum license costs, lower cost per bit

# mm-wave Spectrum: High Frequency Standardization



## Trend of the use of higher frequency bands by fixed radio transmission

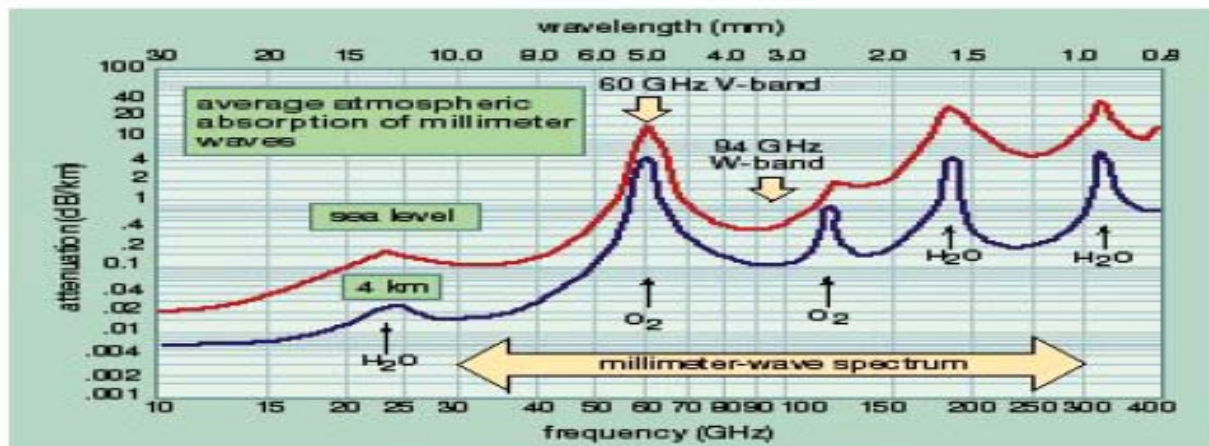


**2012:** ITU-R F.2006 in the 71-76 and 81-86 GHz was adopted

**2012:** ITU-R F.2004 about 92-95 GHz was adopted

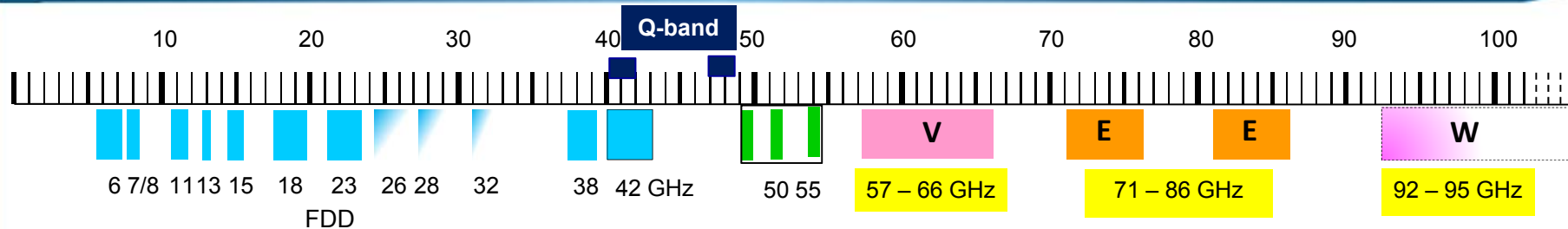
**2011:** ITU-R F.2107 Report covering up to 134 GHz was approved

**2015:** Ongoing questionnaire for the revision of the ECC Report 173 on spectrum requirements



95-100 GHz
102-105 GHz
105-109.5 GHz
111.8-114.25 GHz
122.25-123 GHz
130-134 GHz
141-148.5 GHz
151.5-164 GHz
167-174.8 GHz
Higher

# mm-wave Spectrum: Below 95 GHz



## from <26 GHz to 42 GHz

- Some frequencies below about 26 GHz and about 38 GHz are densely used
- 28/32/42 GHz seldom used
- 26/28/32 GHz partly or entirely block licensed in many countries for PmP

## Q-band, 50 to 55 GHz, 92-95 GHz

- **Very small** to be significant when compared with V-band and E-band, with **no components, antennas and systems available**

## V-band (57 to 64, 64 to 66 GHz)

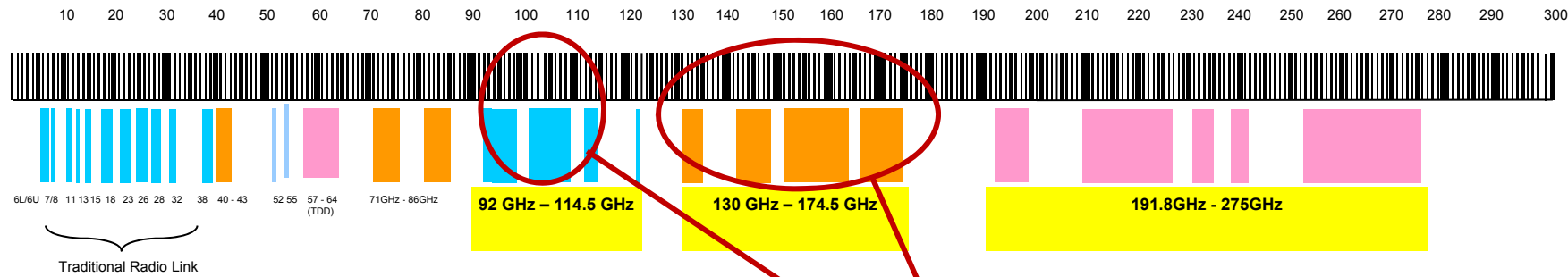
- **License-exempt** / block license for SCBH, enterprises
- TDD, FDD, in future Full Duplex
- **Very fragmented with allocation of sub-bands on several services**

## E-band (71 to 76, 81 to 86 GHz)

- Capable of transmission of **multi-Gbit/s over few kilometers** at reasonable TCO
- **Link-by-link license**, either **individual** or **light license** for Macro Backhaul, aggregation
- **FDD**, channels from 250 MHz to 2 GHz

**Necessity for the industry to focus investments**

# mm-wave Spectrum: Above 90 GHz



## “TeraHz” (>90 GHz)

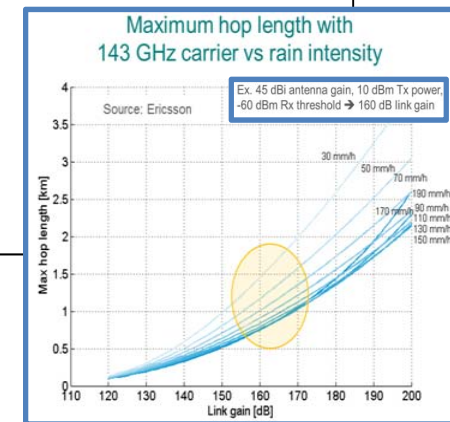
Suitable for applications such as:

- Very high capacity backhaul (multi-10Gbit/s)
- Fronthaul
- Fixed Wireless Access

## Most promising TeraHz bands:

- 92 to 114.5 GHz (W-band)
- 130 to 174.5 GHz (D-band)

Dedicated new ISG Work Item  
“Analysis of spectrum, license schemes and network scenarios in W-band and D-band”



Necessity to properly regulate newly available spectrum

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# ETSI mWT ISG Main Milestones



Launch of the **mWT** forum  
@ **Layer123** in **Dusseldorf** by founding  
members

09-2014



Early 2014

Early discussions, founding members,  
preliminary agreements

Establishment of the new **ETSI** Industry Specification  
Group (**ISG**) on millimetre Wave Transmission (**mWT**)

12-2014

ISG mWT **Plenary Meeting #1 & #2**  
in Sophia Antipolis

01-2015  
& 05-2015

ISG mWT **Plenary Meeting #3** in London

09-2015



# Members & Participants



## SYSTEM VENDORS

### Alcatel-Lucent (FR)\*

Aviat Networks (UK) Ltd

Blu Wireless Technology Ltd (GB)

Ceragon Networks AS (NO)

DragonWave S.a.r.l (LU)

E-Blink s.a. (FR)

### Ericsson LM (SE)\*

Fastback Networks (US)

Huawei Technologies (SE)

### Huawei Technologies Co. Ltd (GB)\*

NEC Corporation (JP)

### NEC Europe LTD (GB)\*

Nokia Solutions and Networks Gmbh & Co. KG (DE)

Samsung Electronics (UK)

SIAE Microelettronica SpA (IT)

Siklu Communication Ltd. (IL)

## OPERATORS

### Deutsche Telekom AG (DE)\*

DOCOMO Communications  
Laboratories Europe GmbH (DE)

### EE Limited (GB)\*

SK Telekom (KR)

TELECOM ITALIA S.p.A. (IT)

### VODAFONE Group Plc (GB)\*

## INSTITUTES, GOVERNMENT

Commissariat à l'énergie atomique  
et aux énergies alternatives (FR)

FBConsulting S.A.R.L. (LU)

French Ministry of Economy,  
Industry and Digital Affairs (FR)

IMEC

Layer123 (GB)

National Physical Laboratory (GB)

Xona Partners

## ANTENNA, COMPONENTS, INSTRUMENTS SUPPLIERS

### Andrew AG (CH)\*

BROADCOM CORPORATION (US)

HUBER+SUHNER AG (CH)

### INFINEON TECHNOLOGIES (DE)\*

Intel Deutschland GmbH (DE)

InterDigital Communications (US)

JDSU Deutschland GmbH (DE)

ROBERT BOSCH GmbH (DE)

Filtronic Broadband Ltd (GB)

Plasma Antennas Ltd (GB)

STMicroelectronics (CH)

\* Founding Members

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## Motivation of ETSI mWT ISG



The **mWT ISG** aims to facilitate the use of the **V-band** (57-66 GHz), the **E-band** (71-76 & 81-86 GHz) and in the future **higher frequency** bands (**from 50 GHz up to 300 GHz**) for large volume applications in the **back-hauling** and **front-hauling** to support mobile network implementation, wireless local loop and any other service benefitting from high speed wireless transmission.





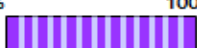

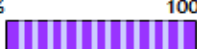







**The mWT ISG aims to be a worldwide initiative with global reach**

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# Results of the Technical Works (1)



WI	Title	Scope of Work Item (WI) and Highlights	Status
1	<b>Maturity and field proven experience of millimetre-wave transmission</b>	Intended to <b>enhance the confidence in millimetre wave transmission (mWT)</b> . Overview of propagation and availability models for mWT with measurement results and experience from field trials. Additional experience in new dense urban street level environment also addressed.	- completed - published 0%  100% 
2	<b>Applications and use cases of millimetre-wave transmission</b>	Provides <b>Group Specifications on potential transmission applications and use cases for millimetre wave spectrum technology</b> , providing key requirements per transmission application / use cases.	- completed - published 0%  100% 
3	<b>Overview on V-band and E-band worldwide regulations</b>	Provides <b>an updated overview on the regulation and spectrum allocation of both V-Band and E-Band</b> . Two relevant deliverables are the mentioned white paper and a <b>“live” database</b> in which the updated country by country allocation is collected.	- completed - published 0%  100% 
4	<b>V-band street level interference analysis</b>	Aimed to provide an informative Technical Report to investigate the feasibility of using unlicensed band by <b>analysing interference levels in co-channel and adjacent channels in dense deployment of PP radio at street level</b> . Extended the scope of work to cover WI #10 and #11	- early draft available - final draft January 0%  100% 
5	<b>Millimetre-wave semiconductor Industry technology status and evolution</b>	Informative purpose, to provide a whitepaper about an overview of semiconductor technologies in the millimetre-wave.	- draft available - final draft January 0%  100% 
6	<b>Antennas</b>	Analysis of the <b>antenna use cases for PtP and PmP mm-wave links</b> : Installation and form factor topics, regulatory complexity, phased array or beam forming... Impact of new use cases on antenna characteristics: @ roof top to street level.	- completed - remote consensus 0%  100% 

# Highlights on WI #1: Maturity and field proven experience of mmw transmission



## E-band trials

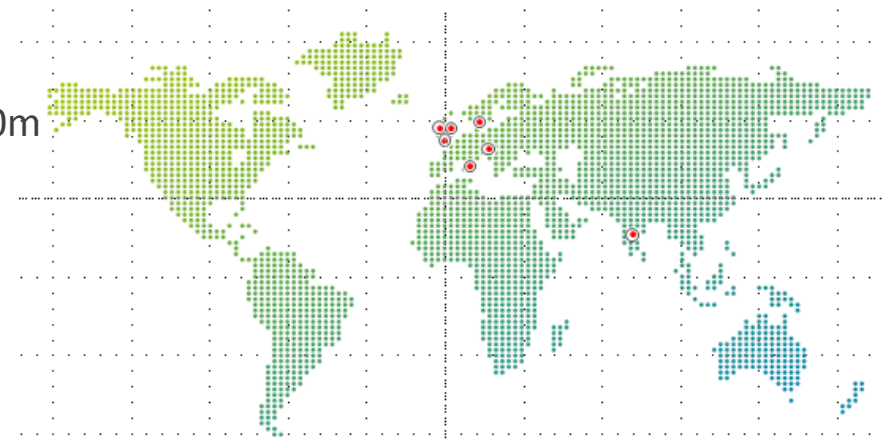
- **Vodafone:** Performance comparison between 80 GHz and 38 GHz link over the same path, Budapest, Hungary
- **Vodafone + Huawei:** Availability predictions compared to measurements, 1 – 4 km, Basingstoke, UK
- **Telecom Italia + Huawei:** Fading predictions compared to measurements, 2.1km, Turin, Italy
- **Ericsson:** Fading and rain predictions compared to long-term measurements, 1km and 1.35km, Göteborg, Sweden
- **Siklu:** Monsoon trials, 750m and 1.4km, Mumbai, India

## V-band trials

- **Vodafone + Ericsson:** Availability predictions compared to measurements, 64m and 273m, Newbury, UK
- **EE + NEC:** Bristol, UK
- **Siklu:** Street-level live traffic trial, 85m and 200m

## Other input

- **Nokia:** Mast sway



# Highlights on WI #2: Applications and use cases of mmw transmission (1)



MACRO-CELL			
<b>B A C K H A U L</b>	Topology		Mobile network upgrade, expansion
	Capacity		≈ 2 Gbps/site
	Link latency		< 1 ms (even down to 0.2 ms wrt direct X2)
	Range		< 5 km
	Architecture		PtP LoS
	Alignment		Auto-alignment (wrt relatively long ranges)
	License regime		Licensed/Light-licensed/Block-allocation
<b>F R O N T H A U L</b>	Topology		Mobile network upgrade, expansion
	Capacity		≈ 18.4-58.9 Gbps or ≈ 8.0-24.3 Gbps (w/ ORI compression)
	BBU-RRU latency		< 100 μs
	Alignment		Auto-alignment (wrt relatively long ranges)
	License regime		Licensed/Light-licensed/Block-allocation



# Highlights on WI #2: Applications and use cases of mmw transmission (2)



SMALL-CELL			
B A C K H A U L	Topology		Macro-to-street, multi-hop
	Capacity		≈ 1 Gbps/site
	Link latency		< 1 ms (even down to 0.2 ms wrt direct X2)
	Range		< 500 m
	Architecture		PtP/PmP/LoS/nLoS/NLoS
	Alignment		Auto-alignment with appropriate form factor
	License regime		License exempt/Light-licensed/Block-allocation
F R O N T H A U L	Topology		Macro-to-street, multi-hop
	Capacity		≈ 2.4-9.8 Gbps or ≈ 1.0-4.1 Gbps (w/ ORI compression)
	BBU-RRU latency		< 100 μs
	Alignment		Auto-alignment with appropriate form factor
	License regime		License exempt/Light-licensed/Block-allocation

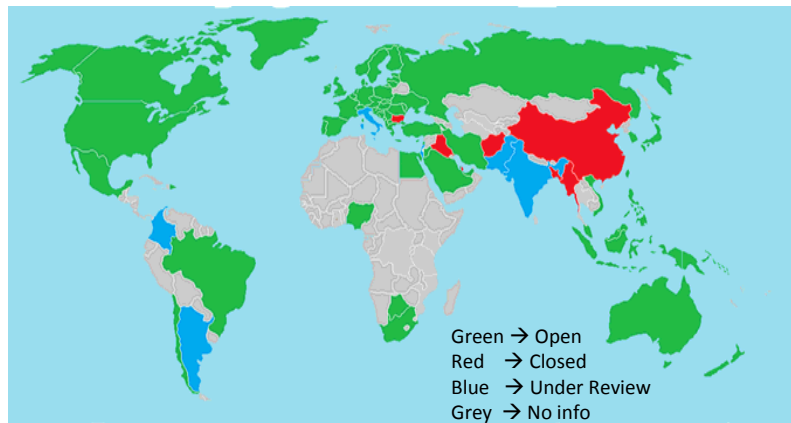
# Highlights on WI #3: Overview on V & E-band worldwide regulations



Live Database

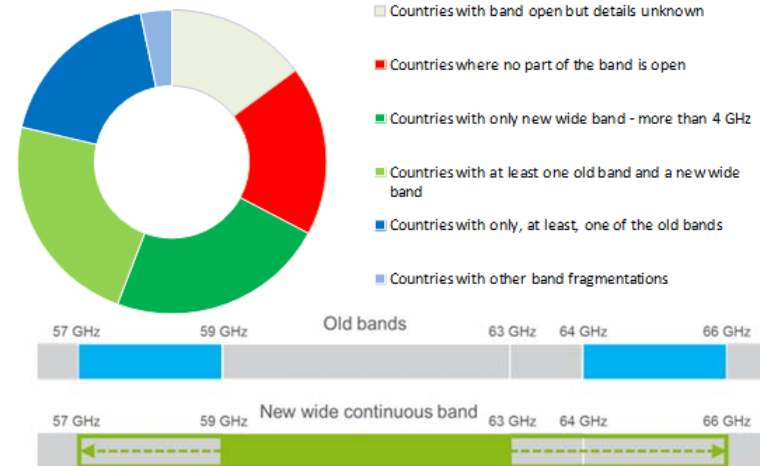
ITU REGION	Telecommunications Regulatory Authorities	Website	Country	Freq. Band [GHz]	Status of the band	Channel spacing [MHz]	FDD/TDD	License Regime	Notes
REG 3	Comision Regulacion de Telecomunicaciones	<a href="http://www.crt.gov.co/">http://www.crt.gov.co/</a>	Myanmar	57-66	Closed				
REG 1	Hakom - Croatian Regulatory Authority for	<a href="http://www.hakom.hr">http://www.hakom.hr</a>	Netherlands	57-66	Open		FDD/TDD	Light licensing	TDD seems limited to <a href="https://www.dia.gov.nz/Publicforms.nsf/NZGZT/NZGazette119Oct14.pdf?file/NZGazette119Oct14.pdf">https://www.dia.gov.nz/Publicforms.nsf/NZGZT/NZGazette119Oct14.pdf?file/NZGazette119Oct14.pdf</a>
REG 1	Czech Telecommunications Office	<a href="http://www.ctu.cz/">http://www.ctu.cz/</a>	New Zealand	57-66	Open				57-64 GHz is allocated for fixed services according toCEPT REC/04014 The
REG 1	Agency	<a href="http://www.tst.dk/">http://www.tst.dk/</a>	Norway	57-64	Open	50,00	FDD/TDD	Licensed	
REG 1	ECTEL Eastern Caribbean Telecommunications Authority	<a href="http://www.ectel.info/">http://www.ectel.info/</a>	Norway	57-59	Open	rx50	FDD/TDD	Unlicensed	Additional information fees: Opt1: 1PLN; Opt2: 61€
REG 2			Poland	61-64	Open	rx50	FDD/TDD	Licensed	
REG 1			Poland	64-66	Open	rx50	FDD/TDD	Licensed	
REG 1			Portugal	57-59	Open	n*50	FDD/TDD	Licensed	ANACOM - Administrative Rule no. 1473-B 2008 1.4 - Fees due for the use of frequencies for the fixed service. The fixed links are always licensed (fees ) Where L stands for
REG 1			Portugal	59-63	Open	n*50			
REG 1	Autoridade Nacional de Comunicações (ANACOM)		Portugal	64-66	Open	n* 30-50			

Worldwide Status of E and V-band



E-band case

Global implementation of V-band



V-band case

# PUBLICATIONS



ETSI White Paper No. 9

## E-Band and V-Band - Survey on status of worldwide regulation

First edition – June 2015

ISBN No. 979-10-92620-06-1

Author:  
Mario Giovanni Luigi Freccasetti

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ETSI White Paper No. 10

## Maturity and field proven experience of millimetre wave transmission

First edition – September 2015

ISBN No. 979-10-92620-07-8

Editor:  
Mikael Coldrey

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ETSI GS mWT 002 v1.1.1 (2015-08)



## millimetre Wave Transmission (mWT); Applications and use cases of millimetre wave transmission

### Disclaimer

This document has been produced and approved by the millimetre Wave Transmission (mWT) ETSI Industry Specification Group (ISG) and represents the views of those members who participated in this ISG. It does not necessarily represent the views of the entire ETSI membership.

# Results of the Technical Works (2)



WI	Title	Scope of Work Item (WI) and Highlights	Status
7	5G spectrum usage	ISG mWT <b>view on 5G spectrum usage</b> , aimed to produce material reflecting current usage & trends of spectrum for fixed services in order to contribute to IMT2020 spectrum discussion on future need of spectrum for backhaul.	- completed 
8	Study of new frequency bands above 90 GHz	Prepared a first proposal remotely discussed and approved by the ISG mWT. Submitted to CEPT ECC SE19 the proposal, accepted, to open two WI's for respectively W-Band and D-Band. WI to define use cases, channel plans, ..	- draft proposal distributed 
9	Active Antennas	To be confirmed at the outcome from WI#6 on Antennas.	- Expected first draft
10	V-Band NLoS	Prosecution of WI#4, <b>inter-system interference in the V-band, including the WiGig potential interference</b> . Going to be integrated in WI #4	- Incorporated in WI#4
11	V-Band nLoS/NLoS interference analysis simulations	<b>V-band LoS/nLoS/NLoS interference simulations</b> using Seamcat Going to be integrated in WI #4	
12	New use cases	Second phase of Work Item#1	- put on stand-by 
13	V-Band nLoS/NLoS trials	V-band LoS/nLoS/NLoS trials	- put on stand-by, waiting for first trial results 

# WELCOME TO THE mWT ISG



The mWT ISG is open to all ETSI members and non-members

For full details of the mWT ISG including

ToR – Members and Participants agreements and how to join please visit

<http://portal.etsi.org/tb.aspx?tbid=833&SubTB=833>

Join now



Thank you!