



Regulatory Landscape for Terragraph



How is Facebook enabling an ecosystem around Terragraph?



Technology Innovation

- Free technology licensing to OEMs
- SW/FW Development - L2/L3, interop etc.
- Chipset and Modules - sourcing & validation
- Enabling OEM/SI with network planning & management tools
- Standardization - 802.11ay; Wi-fi Alliance



Spectrum

- Delicensing 60GHz for outdoor use
- Demonstrate technology & value
- Help define public private partnerships



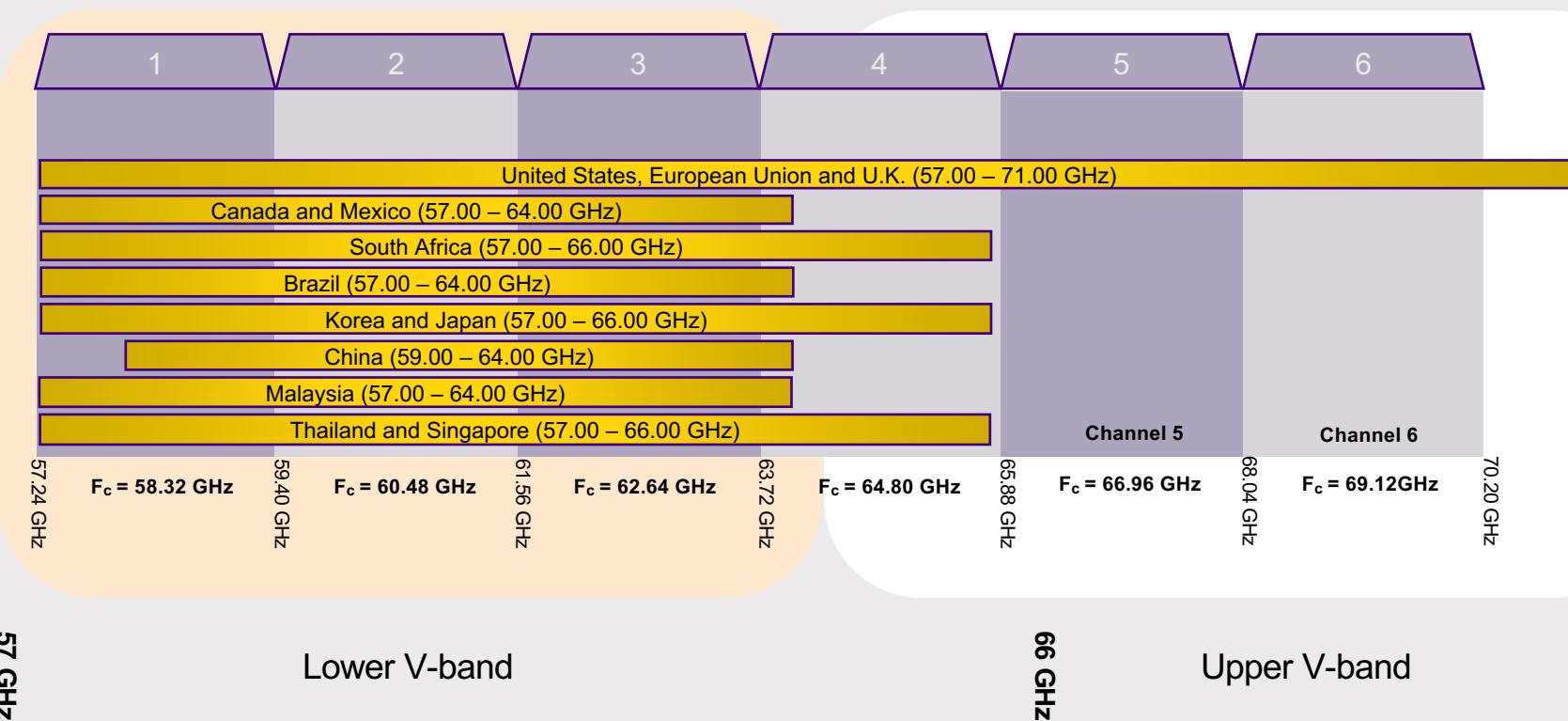
Ecosystem Engagement

- Industry evangelism and engagement
- Direct promotion to service providers
- Pilot market trials with strategic operators
- Support OEM/SI go-to-market activities

Facebook Connectivity serves as a technical advisor for the trial supporting GlobalNet and their selected OEM.

Regulatory Momentum around 60Ghz

60 GHz Band (V Band) widely available



ITU Frequency Allocation

International Table		
Region 1 Table	Region 2 Table	Region 3 Table
56.9-57		
EARTH EXPLORATION-SATELLITE (passive)		
FIXED		
INTER-SATELLITE 5.558A		
MOBILE 5.558		
SPACE RESEARCH (passive)		
5.547 5.557		
57-58.2		
EARTH EXPLORATION-SATELLITE (passive)		
FIXED		
INTER-SATELLITE 5.556A		
MOBILE 5.558		
SPACE RESEARCH (passive)		
5.547 5.557		
58.2-59		
EARTH EXPLORATION-SATELLITE (passive)		
FIXED		
MOBILE		
SPACE RESEARCH (passive)		
5.547 5.556		
59-59.3		
EARTH EXPLORATION-SATELLITE (passive)		
FIXED		
INTER-SATELLITE 5.556A		
MOBILE 5.558		
RADIOLOCATION 5.559		
SPACE RESEARCH (passive)		

59.3-64	
FIXED	
INTER-SATELLITE	
MOBILE 5.558	
RADIOLOCATION 5.559	
5.138	
64-65	
FIXED	
INTER-SATELLITE	
MOBILE except aeronautical mobile	
5.547 5.556	
65-66	
EARTH EXPLORATION-SATELLITE	
FIXED	
INTER-SATELLITE	
MOBILE except aeronautical mobile	
SPACE RESEARCH	
5.547	
66-71	
INTER-SATELLITE	
MOBILE 5.553 5.558	
MOBILE-SATELLITE	
RADIONAVIGATION	
RADIONAVIGATION-SATELLITE	

See <https://transition.fcc.gov/oet/spectrum/table/fccitable.pdf>

Multiple Gigabit Wireless Systems for 60 GHz Band

Recommendation **ITU-R M.2003**, Multiple Gigabit Wireless Systems in frequencies around 60 GHz, provides general characteristics and radio interface standards for 60 GHz band MGWS. In developing this recommendation, the ITU Radiocommunication Assembly (RA) considered that:

- Multiple Gigabit Wireless Systems (MGWS) are widely used for fixed, semi-fixed (transportable) and portable computer equipment for a variety of broadband applications
- MGWS are expected to encompass applications for wireless digital video, audio, and control applications, as well as multiple gigabit wireless local area networks (WLAN) and point-to-point close proximity mobile system
- MGWS standards have been developed for operation in the 60 GHz frequency range
- MGWS should be implemented with careful consideration to compatibility with other radio applications
- many administrations permit MGWS including radio local area networks (RLANs) and personal area networks (WPANs) devices to operate in the 60 GHz frequency range on a license exempt basis
- harmonized frequencies in the 60 GHz frequency range for the mobile service would facilitate the introduction of MGWS including RLANs.

WRC-19 resolution

Allocation to services		
Region 1	Region 2	Region 3
66-71	INTER-SATELLITE MOBILE 5.553 5.558 5.559AA MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.554	

ADD

5.559AA The frequency band 66-71 GHz is identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which this frequency band is allocated and does not establish priority in the Radio Regulations. Resolution **241 (WRC-19)** applies. (WRC-19)

See https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-WRC.14-2019-PDF-E.pdf

CEPT (48 member states)

ERC Recommendation 70-03

ERC RECOMMENDATION (70-03) Page 15

ANNEX 3: WIDEBAND DATA TRANSMISSION SYSTEMS

Scope of Annex

This annex covers frequency bands and regulatory as well as informative parameters recommended for Wideband Data Transmission Systems.

Table 3: Regulatory parameters

Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation / maximum occupied bandwidth	ECC/ERC Deliverable	Notes
a1	863-868 MHz	25 mW e.r.p.	≤ 10% duty cycle for network access points and polite spectrum access, ≤ 2.8% duty cycle otherwise and polite spectrum access	> 600 kHz ≤ 1 MHz	Wideband data transmission in data networks (note 1). The frequency band is also identified in Annexes 1, 2, 10 and 11
a2	915.8-919.4 MHz	25 mW e.r.p.	≤ 10% duty cycle for network access points and polite spectrum access, ≤ 2.8% duty cycle otherwise and polite spectrum access	> 600 kHz ≤ 1 MHz	Wideband data transmission in data networks (notes 1 and 2). All nomadic and mobile devices within the data network shall be controlled by a master network access point (NAP). The frequency band is also identified in Annexes 1, 2 and 11
b	2400-2483.5 MHz	100 mW e.i.r.p.	Adequate spectrum sharing mechanism (e.g. LBT and DAA) shall be implemented	Not specified	For wideband modulations other than FHSS, the maximum e.i.r.p. density is limited to 10 mW/MHz
c2	57-71 GHz	40 dBm e.i.r.p., 23 dBm/MHz e.i.r.p. density and maximum transmit power of 27 dBm at the antenna port or ports	Adequate spectrum sharing mechanism shall be implemented	Not specified	ECC Report 288
c3	57-71 GHz	55 dBm e.i.r.p., 38 dBm/MHz e.i.r.p. density and transmit antenna gain ≥ 30 dBi	Adequate spectrum sharing mechanism shall be implemented	Not specified	ECC Report 288 Applies only to fixed outdoor installations

network. The term data network refers to several short range devices, including the network access point, as network components and to the wireless connections between them.

Edition of June 2019

See ERC Recommendation 70-03, Annex 3 <https://www.ecodocdb.dk/download/25c41779-cd6e/Rec7003e.pdf>



EU mandate (27 member states)

Band no	Frequency band	Category of short-range devices	Transmit power limit/field strength limit/power density limit	Additional parameters (channelling and/or channel access and occupation rules)	Other usage restrictions	Implementation deadline
75	57-71 GHz	Wideband data transmission devices	40 dBm e.i.r.p. and 23 dBm/MHz e.i.r.p. density	Requirements on techniques to access spectrum and mitigate interference apply [7].	Fixed outdoor installations are excluded.	1 January 2020
75a	57-71 GHz	Wideband data transmission devices	40 dBm e.i.r.p., 23 dBm/MHz e.i.r.p. density and maximum transmit power of 27 dBm at the antenna port or ports	Requirements on techniques to access spectrum and mitigate interference apply [7].		1 January 2020
75b	57-71 GHz	Wideband data transmission devices	55 dBm e.i.r.p., 38 dBm/MHz e.i.r.p. density and a transmit antenna gain $\geq 30 \text{ dBi}$	Requirements on techniques to access spectrum and mitigate interference apply [7].	This set of usage conditions is only available to fixed outdoor installations.	1 January 2020

See SRD 7th update Decision (EU) 2019/1345 adopted on 2 August 2019 and published at

<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1567676305871&uri=CELEX:32019D1345>

United States FCC

§15.255 Operation within the band 57-71 GHz.

...

(c) Within the **57-71 GHz** band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

- (1) Products other than fixed field disturbance sensors and short-range devices for interactive motion sensing shall comply with one of the following emission limits, as measured during the transmit interval:
 - (i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed **43 dBm**; or
 - (ii) For **fixed point-to-point transmitters located outdoors**, the average power of any emission shall not exceed **82 dBm** and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

See United States eCFR §15.255: Operation within the band 57-71 GHz

https://www.ecfr.gov/cgi-bin/text-idx?node=pt47.1.15&rgn=div5#se47.1.15_1255

60 GHz Regulatory Momentum in APAC

Country	Unlicensed Band	EIRP	License Exempt	Indoor /outdoor
Australia	57-71 GHz	43 dBm	yes	both
	57-71 GHz	82 dBm ¹	yes	outdoor
Indonesia	57-64 GHz	-	yes	Indoor
Japan	57-66 GHz		yes	both
Malaysia	57-64 GHz	40 dBm	yes	both
New Zealand	57-66 GHz	43 dBm	yes	indoor
	57-64 GHz	43 dBm	yes	both
Philippines	57-66 GHz		yes	both
Singapore	57-66 GHz	40 dBm	yes	indoor
	57-66 GHz	25 dBm	yes	outdoor
South Korea	57-66 GHz		yes	both
Thailand	57-66 GHz	40 dBm	yes	both (WLAN/WPAN/PMP))
	57-66 GHz	82 dBm ¹	yes	outdoor (P2P)
Taiwan	57-66 GHz	40 dBm	yes	both
	57-66 GHz	82 dBm ¹	yes	outdoor

¹ EIRP for 55dBi antenna. 2dB EIRP reduction for each dB of reduction of antenna gain

Technologies in the 60Ghz

Technologies in 60Ghz



IEEE 802.11ad

- First IEEE 802.11 amendment designed for the 60 GHz band
- Key technical features:**
 - Maximum data rate of 8 Gbps
 - 2.16 GHz channels, single-stream operation (SISO)
 - Medium access: Scheduled and contention access
 - Beamforming protocols: Sector level sweep (SSW) and beam refinement (BRP)
- WiGig certification**

IEEE 802.11ay

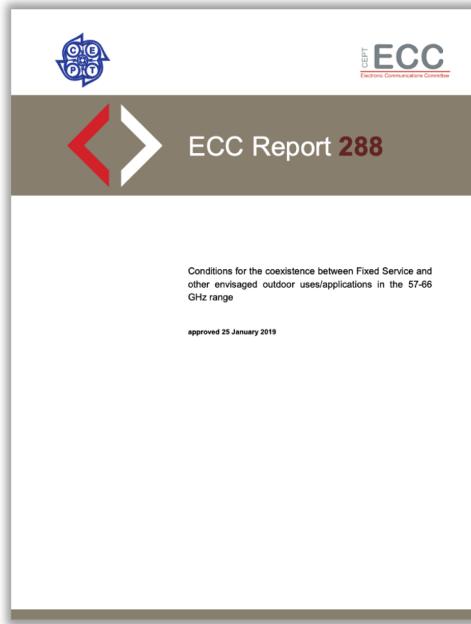
- Next generation standard after IEEE 802.11ad
- Key technical features:**
 - Channel bonding: 2.16 GHz, 4.32 GHz, 6.48 GHz, and 8.64 GHz channels
 - MIMO operation, up to 8 streams, and downlink multi-user (MU) transmissions
 - New medium access scheme for fixed wireless access applications
 - Time division duplex (TDD) service period
 - Supports Facebook Terragraph, multi-hop back-haul 60 GHz system for street level deployments
 - Enhanced beamforming protocols, support to multi-channel operation and MIMO
- On-going 60 GHz Fixed Wireless certification program: <https://www.wi-fi.org/who-we-are/current-work-areas>

60 GHz Coexistence for FWA

IEEE 802.11ad/ay, ETSI and CEPT

- IEEE 802.11ad/ay define several features that facilitate co-existence with itself and other systems, including:
 - Listen-before-talk (LBT)
 - Channelization and DFS
 - Transmit power control (TPC)
 - Beamforming
- Listen-Before-Talk (LBT) for Mobile Applications
 - ETSI EN 302 567 :"Multi-Gigabit/s Radio Equipment operating in the 60 GHz Band"
- Beam steering and Automatic Transmit Power Control for Fixed Networks
 - ETSI TR 103 "Fixed Radio Systems: Point-to-point systems; ATPC, RTPC Adaptive Modulation (mixed-mode) and Bandwidth Adaptive functionalities
 - ETSI mmWT ISG Report on 3D Ray Tracing
 - CEPT Report 288

CEPT concludes that sharing is feasible between FS, FWA and SRD



- ❖ **Detailed report on V-band coexistence**
 - Self interference of Fixed Wireless Access Point-to-Multipoint (FWA)
 - Impact of Fixed Wireless Access on Fixed Services (Point-to-Point)
 - Impact of Fixed Wireless Access on Short Range Communications (SRD)
- ❖ **Range of Coexistence Techniques Considered**
 - Dynamic Frequency Selection
 - Automatic Transmit Power Control
 - Synchronization and Coordinated Mode of Operation
 - Listen – before – Talk
 - High Directivity Antennas, beam forming & nulling
- ❖ **Conclusion:**
 - Sharing is feasible
 - Techniques for managing Self-interference also enable sharing between different use cases

Recommendation

For
Discussion

1. *The 60 GHz band (57-71 GHz) should be opened under a license-exempt framework for both mobile and fixed use, without outdoor restriction, for optimal utilization*
2. *60 GHz band spectrum should allow for flexible use and should not establish coordination or channelization requirements.*
3. *Suggested regulatory framework: either CEPT (ERC Recommendation 70-03) or FCC (CFR §15.255)*



Aerial view of a dense residential area with many houses and trees.

THANK YOU

