DRAFT RECOMMENDED STANDARD FOR WIRELESS PROXIMITY NETWORK

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# ~~1~~3 WIRELESS PROXIMITY NETWORKING COMMUNICATIONS RECOMMENDED STANDARDS

## ~~1.1~~3.1 OVERVIEW

This document references and recommends two major standards paths: the Wi-Fi Alliance certifications (heavily drawn from IEEE 802.11 standards) and the 3GPP (LTE and beyond) standards. Subsection 3.2 enumerates the specific recommended IEEE 802.11 Wi-Fi standards, and Subsection 3.3 enumerates the specific 3GPP standards. Both subsections include the recommended spectrum bands for space agency communication assets and equipment in support of exploration mission operations.

This recommended standard does not provide any normative guidance in the frequency values of the permitted bands [in addition to the applicable SFCG band to protect (2483.5-2500 MHz)] by the space systems using the wireless terrestrial standards covered in this book. Consequently, the following implications for the frequency selection are to be followed:

1. The frequency band choices for lunar or martian surface wireless transmissions could be impacted by ITU REC [38] and by the Radio Regulation [39] applicable in the Shielded Zone of the Moon (SZM). Therefore, Adopters must ensure compatibility with ITU Radio Regulations.
2. The "use of any frequency band" shall be verified liaising with RFM WG before selecting any of non-SFCG wireless frequency band.
3. Space Agencies must ensure clearance for an SFCG Waiver when the chosen frequency band is not recommended in [33] or in [40].
4. A Frequency Usage Verification Procedure needs to be followed as it is defined by the responsible bodies, that can be SLS RLM WG.

~~NOTE – Space agency mission design personnel must ensure supporting RF communications equipment and devices are licensed permitted for operation in space environments.3839Space Agencies ITU Radio Regulations andn[33]~~

## ~~1.2~~3.2 IEEE 802.11 STANDARDS

### ~~1.2.1~~3.2.1 GENERAL

Space exploration vehicles, gateways, and planetary surface elements shall incorporate Wi-Fi infrastructure to support internal and external, low-mobility, short-range, non-critical, wireless-extended network interoperable communications.

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### ~~1.2.2~~3.2.2 IEEE 802.11 WI-FI

Infrastructure shall be compliant with Wi-Fi CERTIFIED 6™.

NOTE – Rationale: IEEE 802.11-based products are widely utilized terrestrially with a large COTS provider base and attendant reliability. IEEE 802.11ax offers very high data rates, higher quality of service, increased interference resilience, increased range, addresses hidden and exposed node issues, can be operated at 2.4 GHz or 5 GHz, and Wi-Fi CERTIFIED 6™ products have been increasingly available since late 2019.

For 5 GHz implementations, infrastructure may be compliant with Wi-Fi CERTIFIED ac.

NOTE – Rationale: IEEE 802.11-based products are widely utilized terrestrially with a large COTS provider base and attendant reliability. IEEE 802.11ac has replaced IEEE 802.11n as the most available 5 GHz variant currently on the market supporting high-rate data communications.

Infrastructure may be compliant with Wi-Fi CERTIFIED n.

NOTES

1 Rationale: IEEE 802.11-based products are widely utilized terrestrially with a large COTS provider base and attendant reliability. IEEE 802.11n was recently the most advanced 2.4 GHz variant on the market supporting mid-rate data communications and has significant space heritage.

2 IEEE 802.11n (Wi-Fi 4) products will quickly become obsolete and deprecated in the wireless market. Mission designers should only consider IEEE 802.11n products for legacy system maintenance and operational support.

3 It is the responsibility of wireless communication system planners to follow the specific Wi-Fi channel plan specified by the mission infrastructure for multi-agency interoperable wireless communications.

4 In support of interoperable 802-11-based Wi-Fi communications, the CCSDS leverages the interoperability test suite of the Wi-Fi Alliance. Adherence to the attendant Wi-Fi certifications and sub-certifications for Wi-Fi 4 (802.11n), Wi-Fi 5 (802.11ac), and Wi-Fi 6 (802.11ax) provides the basis for multi-agency interoperable Wi-Fi wireless communication systems. For highly mobile clients it is recommended that Wi-Fi clients support the Wi-Fi Alliance Request-to-send/Clear-to-send (RTS/CTS) certification.

### ~~1.2.3~~3.2.3 IEEE 802.11 SECURITY

For all implementations, security shall be compliant with Wi-Fi CERTIFIED WPA2-Enterprise™.

NOTE – Rationale: IEEE 802.11 based products are widely utilized terrestrially with a large COTS provider base and attendant reliability. WPA2 is recommended for backward compatibility. WPA2 is recommended to be disabled unless necessary to support legacy designs.

For all implementations, security should be compliant with Wi-Fi CERTIFIED WPA2-Personal™.

NOTE – Rationale: IEEE 802.11-based products are widely utilized terrestrially with a large COTS provider base and attendant reliability. WPA3 is recommended for all new designs (reference **Erreur ! Source du renvoi introuvable.**~~[27]~~).

### ~~1.2.4~~3.2.4 IEEE 802.11 WIRELESS PROFILES

All client implementations should be configurable with multiple profiles (reference **Erreur ! Source du renvoi introuvable.**~~[29]~~).

NOTE – Rationale: Any client lacking support for multiple wireless profiles imposes a constraint on network configuration. Network managers may offer multiple profiles for a variety of purposes including, for example, network ownership, traffic isolation, mobility, service expansion, technology upgrades, and/or configuration maintenance. Short-duration or expendable clients may be exempted.

### ~~1.2.5~~3.2.5 IEEE 802.11 CHANNEL PLAN

All infrastructure implementations shall use channel assignments conforming to the respective IEEE 802.11 standards, while respecting guard bands defined by SFCG [**Erreur ! Source du renvoi introuvable.**], [40].~~.~~

Commenté [KKG2]: Put cautionary guard band text in applicable section of Ch. 2

NOTE – Rationale: This Recommended Standard intends that infrastructures operating in space should support commercially available terrestrial client devices, including those with pre-integrated Wi-Fi. The IEEE 802.11 standards (IEEE 802.11-2020, IEEE 802.11ax Draft 6) generally define standard channels in an annex E, Country elements and operating classes. This Recommended Standard is not requiring a specific terrestrial regional channel set.

NOTE – ~~The frequency band choices for the lunar surface wireless transmissions could be impacted by ITU REC [38] and by the Radio Regulation [39] applicable in the Shielded Zone of the Moon (SZM). Space Agencies must also ensure~~

~~compatibility with ITU Radio Regulations and SFCG frequency bands, or if not ensure clearance for an SFCG Waiverfchosen[33].~~

NOTE – ~~like for instance the 3.5 MHz guard band defined between the 2400-2480 MHz wireless lunar band and the 2483.5-2500 MHz orbit to surface communication band.~~The 300 MHz to 2 GHz range should be reserved for radio astronomy observations [**Erreur ! Source du renvoi introuvable.**].

~~NOTE Rationale: This Recommended Standard intends that infrastructures operating in space should support commercially available terrestrial client devices, including those with pre-integrated Wi-Fi. The IEEE 802.11 standards (IEEE 802.11-2020, IEEE 802.11ax Draft 6) generally define standard channels in an annex E, Country elements and operating classes. This Recommended Standard is not requiring a specific terrestrial regional channel set.~~NOTE – Due to the specific Radio Regulation applicable in the SZM, a transmission in that zone should be declared to the ITU and ~~prior~~ coordinated previously with ~~to~~ Radio Astronomy representatives, including when declared ~~even~~ on a Non Interference Basis [**Erreur ! Source du renvoi introuvable.**].

## ~~1.3~~3.3 3GPP STANDARDS

### ~~1.3.1~~3.3.1 GENERAL

Space agency exploration communications elements shall incorporate 3GPP LTE infrastructure to support internal and external, high-mobility, mission-critical, short-to-long range, wireless interoperable network communications.

~~NOTE It is important that implementations of a 3GPP LTE network implement network function positioning and inter-function communications to ensure that latency on each interface is as required for each mission design.~~

Outside of the frequency bands used by Wi-Fi devices, implementations shall be compliant with 3GPP LTE Rel-12.

In any case, radiated volontary emissions (in allocated channels) and unvolontary emissions (from corresponding spurious) made by RF wireless transmitting devices of all types in the lunar or martian environment, which would cause frequency overlaps with the lunar and martian communication orbit to surface bands of 2483.5-2500 MHz [33], [40] shall not be permitted. The related SFCG lower guard band [33], [40] protecting this orbit to surface band shall not be overlaped. The Adopter should also define an upper guard band to protect this orbit to surface band.

NOTE – It is important that implementations of a 3GPP LTE network implement network function positioning and inter-function communications to ensure that latency on each interface is as required for each mission design.

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**Commenté [KKG3]:** SOIS-WIR accepts this proposed update provided by CNES/Jean-Luc Issler

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**Commenté [KKG4]:** SOIS-WIR accepts this proposed update provided by CNES/Jean-Luc Issler

**Commenté [IJ5]:** Accurate mention of the rules are necessary in the red book to reach concensus from the CNES side.

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NOTE – Rationale: 3GPP LTE based products are widely utilized terrestrially with a large COTS provider base and attendant reliability. 3GPP LTE offers high data rates, mission-critical quality of service, and increased interference resilience.

NOTE The SFCG 2483.5-2500 MHz lunar communication band [33] will need protection with a 3.5 MHz guard band. This impacts the use of 2500 MHz and 2600 MHz spectrum region LTE channels in bands specified in [7]. Details of these channels in each band are specified in 3GPP LTE conformance testing requirements [40][41] used to describe both (overlapping) band and frequency information using precise and unique identifiers. Band 53 (TDD, 2483.5-2495 MHz) cannot be used. Other bands are limited to being used in certain channels of those bands, corresponding to minimum E-UTRA Absolute Radio Frequency Channel Number (EARFCN) ranges to ensure that no transmissions occur below 2503.5 MHz. Band 7 (FDD) uplink (2500-2570 MHz, 20750-21449 EARFCN) is limited to channel EARFCNs that are not below 20785 + 5 times the bandwidth of the channel in MHz. Band 41 (TDD, 2496-2690 MHz, 39650-41589 EARFCN) is limited to channel EARFCNs that are not below 39725 + 5 times the bandwidth of the channel in MHz. LTE band 38 (TDD, 2570-2620 MHz, 37750-38249 EARFCN), a sub-band of band 41, is not restricted.

Concerning the use of the 3GPP LTE 4G **XXXXX** wireless standard in the lunar region for surface-to-surface links, its used bands shall be programmed in 2.5035-2.6200 GHz, instead of the 2.496-2.620 GHz band permitted by the corresponding terrestrial standard. This is due to the need of a 3.5 MHz guard band with the SFCG 2483.5-2500 MHz lunar communication band [33], to avoid harmfull interferences between these different links.

Concerning the use of the 3GPP LTE 4G **XXXXX** wireless standard in the lunar region, its used bands shall be programmed in 2.5035-2.6200 GHz, instead of the 2.496-2.620 GHz band permitted by the corresponding terrestrial standard. This is due to the need of a 3.5 MHz guard band with the SFCG 2483.5-2500 MHz lunar communication band [33], to avoid harmfull interferences between these different links.

NOTE – For ITU and SFCG spectrum regulation purposes 3GPP deployments shall avoid harmful interference into the SFCG 2500.0-2503.5 MHz band, without imposing additional constraint, except for filtering to this SFCG band received by a terminal co-located with a 3GPP terminal.

The frequency band choices for lunar surface wireless transmissions could be impacted by ITU REC [38] and by the Radio Regulation [39] applicable in the Shielded Zone of the Moon (SZM). Space Agencies must also ensure compatibility with ITU Radio Regulations and SFCG frequency bands, ensure clearance for an SFCG Waiver[33].

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Commenté [IJ6]: Discussions occurred in CNES this week. The proposla is to come back to the initial CNES proposal. We know, due to the omni directional nature of the links in the 2483.5-2500 MHz band, that there will be harmfull interferences without such a guard band with the already decided SFCG band. CNES proposes to the WG to accept this guard band. This is also necessary for acceptance of the 2.5035-2.6200 GHz band in SFCG 32-2R3. This mandatory point for CNES is necessary for CNES to agree on a concessus. XXXXX has to be nommed in the text.
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